

TROUT WATERS

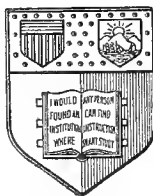


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PREFACE

No merit is claimed by the author for this little book except that it is the result of personal observation, extending over a number of years and a wide area. While it was being written, all books of reference were carefully avoided with a view to the preservation of the personal element.

Omissions and errors there may be, but the work has been conscientiously done, and on that ground must stand for what it is worth.

To Mr. W. Earl Hodgson my thanks are due for his painstaking revision of these chapters, which appeared originally in the *Shooting Times*, to which I am

indebted for permission to publish them in book form.

My thanks are also due to the publishers, Messrs. A. & C. Black, for their advice and help, which have smoothed away many of the difficulties which beset an author.

WILSON H. ARMISTEAD.

THE SCAUR, DALBEATTIE, N.B.,

July 10, 1908.

CONTENTS

CHAPTER I

THE NEED FOR KNOWLEDGE . . .	PAGE 1
------------------------------	-----------

CHAPTER II

BALANCE OF THE SEXES . . .	22
----------------------------	----

CHAPTER III

THE FRY	34
-------------------	----

CHAPTER IV

POISON AND OTHER TROUBLES . . .	45
---------------------------------	----

CHAPTER V

ENEMIES	68
-------------------	----

CHAPTER VI

PROVIDING FOOD AND REDEEMING WASTE . .	82
--	----

TROUT WATERS

CHAPTER VII

	PAGE
LAKES	104

CHAPTER VIII

STOCKING	128
--------------------	-----

CHAPTER IX

PREDATORY FISH	152
--------------------------	-----

CHAPTER X

TROUT THAT DO NOT RISE	164
----------------------------------	-----

CHAPTER XI

A SIZE LIMIT AND ITS RESULTS	177
--	-----

CHAPTER XII

SALMON AND TROUT	189
----------------------------	-----

INDEX	201
-----------------	-----

TROUT WATERS

CHAPTER I

THE NEED FOR KNOWLEDGE

Anglers' Opportunities—Far-reaching Results of Interference—A Stream should be considered as a Whole—Spawning Time—Gravel must be clean—Period of Incubation—Are the Eggs fertile?—Eyed Ova—Embryos' Troubles—Influence of Temperature—The Alevins—Their many Enemies—Artificial Spawning Grounds.

ANGLING affords insight into the life of the silent places, and the angler is frequently permitted to enter the sanctuaries of the wilderness and witness the doings of its inhabitants in a way which is not possible to those who rend the silence of Nature. Bird and beast are his friends, and the motion of his rod is hardly more noticeable than the swaying of a branch in the

wind. Thus many an angler has an exceptional store of knowledge about the habits of wild creatures. This being so, it is strange that the life-history of the fish should frequently be to them a closed book.

A thorough study of the life and habits of the trout, with its requirements not only at different stages of its existence but also during each month in the year—a knowledge of the conditions which go to make up a suitable environment as well as of the many influences against which the fish must contend—is of the utmost value to the angler as well as to the owner of a fishery. The patience necessary for the mastering of details is frequently superseded by a restless energy which induces attempts to improve matters by drastic measures, and then the result is unsatisfactory. Even where a certain measure of success is achieved, it is usually of a very temporary nature, and its cost is out of proportion to the gain.

NEED FOR KNOWLEDGE 3

Any action taken in a trout water must be well considered. The effects are likely to be far-reaching—beyond the ken of those who have not arrived at a knowledge of the interdependence of living things in the water as on the land. Just as the rings made by a rising fish in still water travel in ever-widening circles till they finally disappear, so any tampering with Nature's methods sets influences to work whose effects will be felt by a circle of living creatures in a way perhaps unguessed at. Before attempting the improvement of conditions in any water, it is necessary to know the chain of circumstances which has led to the conditions which exist.

Many an angler equipped with the best and most expensive tackle has met another with tackle of a coarse and homely kind, whose basket contained more fish than had fallen to the dainty flies on finest gut thrown from a rod of scientific make, and marvelled how this could be. The answer is simple. One

man depended on his knowledge, using such gear as came to his hands at small cost ; the other depended on his excellent gear, but had less knowledge. The man who knows will catch fish, whether his tackle cost pounds or shillings. Undoubtedly the better the tackle the better will be his success ; but the man without knowledge can never succeed by virtue of tackle merely. The same considerations apply to the maintenance of a stock of trout. The man who knows will succeed. He who depends on stocking without thought for the welfare of his fish is not likely to do so. Heavy expenditure will never compensate for lack of knowledge, and, while having to pay dearly, he will achieve comparatively poor results.

One reason we so continually hear of the fishing in certain waters falling off is this want of knowledge, and it is responsible for all sorts of mistakes. It is not sufficient that a stream or a lake should be protected ; its natural resources should be developed if the constant toll

of fish taken by the rod is to be maintained.

There are many difficulties in the way of a complete development of most rivers and streams. Perhaps the chief of these is the fact that whilst a trout stream should be treated as a whole, it is usually divided into sections over which different owners have control. This is a very serious handicap, because it is practically impossible to deal with any section of a stream without having regard to the waters above and those below. It is little use one man clearing out the pike if his neighbours preserve them; nor is it encouraging to turn down a stock of trout if they immediately leave the place and take up their quarters on some other man's property. It seldom happens that the portions of a water where trout spawn are favourite places for them during the rest of the year, and it is well for the young fish when they hatch out if there are no large trout about; usually the natural conditions are such that this is

the case. It is a good thing for a trout stream if the various proprietors through whose estates it flows can come to some understanding as to the tactics to be followed on the stream as a whole. Otherwise the best results can never be obtained.

Suppose you take a stretch of water noted for its fishing: you will have trout which have been hatched in one man's water, reared in a stretch belonging to some one else, and spending their maturity in yours. It is obvious, then, that your fishing depends not only on your own watchfulness and care, but also, and to a much greater extent, on that of other people, who have not the same opportunity of reaping the reward. Usually this is recognised, as it ought to be, for there are very few sections of a stream which are capable of affording spawning ground, good rearing ground, and, finally, the rich feeding ground so necessary to the maintenance of heavy fish.

It may be said that, as a general rule, the upper waters and small tributaries of a stream are the most suitable places for the spawning beds. The farther up the old fish go, the safer the fry will be when they hatch out, and the small gravelly streams which form the head waters and are too small to contain large trout are the natural nurseries of the fry.

In swiftly running streams the autumn floods are usually sufficient to clean the gravel on the spawning beds, leaving them ready for the depositing of eggs; but where this is not the case the gravel should be washed by turning it over with a long-toothed rake until the water ceases to be coloured by the operation. It is of the utmost importance that the gravel on the spawning beds should be clean, if the best results are to be obtained. Nature's somewhat haphazard methods have excellent results when she has the management of affairs from start to finish; but when man steps in and takes a heavy harvest of

trout, he must see that there is no waste among the eggs.

Dirt in the gravel of a spawning bed is bad in several ways. It prevents a free run of water ; it adheres readily to the outer shell of the egg ; and it produces, in decay, carbonic acid gas, which is fatal to the growth of the embryo. Cleanliness, on the other hand, increases the chances of fertilisation, which are amazingly uncertain, and allows a continual flow of fresh water through the gravel, from which the embryo is able to absorb in a marvellous manner a supply of oxygen. The result will be strong and healthy fry, capable of making the most of what chances they have of reaching maturity. When we consider that the delicate embryo must lie for a period varying from 40 days to 120 days (according to temperature) in the gravel before hatching, it will be seen how important it is that the conditions under which it exists should be as favourable as possible. Trout are so prolific (about 800 eggs

to the pound weight) that Nature deliberately sets to work as soon as the eggs are deposited to destroy them, and again she thins out the ranks of the fry and places every obstacle in their way, so that only the very fittest may survive, and only a small percentage of these. This point is too often lost sight of by those who advocate protection and natural methods. When man steps in and reaps a harvest he must remove the obstacles placed in the way of the young trout if the seed-time is to be sufficiently productive to maintain their numbers at such a pitch that the harvest may be reaped year after year. Nature will not do it alone; it is necessary that we should help.

When the gravel of the spawning beds has been cleaned and a careful examination reveals no sediment, the next thing to do is to watch for the coming of the spawners. As a rule, they arrive in a body, and in many streams the whole crop of eggs for the season is

deposited in the space of forty-eight hours. This is not always the case; but it may be taken for granted that the spawning season in any water will not last more than a fortnight, though there will always be fish which are abnormally early and late. As a rule, the farther the fish have to go to their spawning ground the shorter will be the spawning season. In a few well-known streams in the south, which are sluggish and fed by springs rising through gravel, the spawning season is spread out over several months, and, though more trout spawn in November than any other month, in these streams they will straggle on till March.

The shorter the spawning season is, the better. There is less danger of early eggs being rooted up by a pair of late fish. Besides, it is well to have all the fry hatching out about the same time, because they will thrive more when they are all one age than if there is a month or six weeks' difference. The

NEED FOR KNOWLEDGE 11

reason for this is that the older fry will bully the younger ones, and it must be remembered that for some time after hatching they are crowded together in narrow and shallow waters.

Make a note of the date of spawning, and it will be found that this will not vary more than a day or two each season. Thus you may know exactly when the fish will be on the beds. During this time they need protection from human and other enemies, and their numbers, size, and condition should be noted and compared with the statistics of other years. The chief points to be observed when the fish are on the beds are whether there is enough room, and whether there is the right proportion of males to females. More often than not, spawning goes on at night, and it is difficult to see the actual fish ; but the condition of the beds next morning will tell you whether they have had room or whether the stock of breeders is becoming low. If all the available ground is disturbed and

ploughed into hills and hollows without regular shape or form, you may conclude that there has not been sufficient room for the fish, and that many eggs have been wasted. If, on the other hand, the hollows made by the fish, and known as "redds," are regular in shape and evenly distributed, with a few smooth places left untouched, you may conclude that there has been no overcrowding. If there are fewer redds than there were in other years, there have been fewer fish.

Now, as to the number of males. If the fish have spawned in the night, it will be impossible to form any idea, because a ripe female will make a redd and deposit her eggs whether there is a mate for her or not. But there is a sure way of telling. A number of redds should be carefully marked (a peg in the bank is a good way), and five or six weeks after the spawning these should be examined. Great care is necessary; but there is no fear of doing harm if the examination is carried out properly. A piece of

NEED FOR KNOWLEDGE 13

mosquito netting on a wire ring will form a useful net for the work, and this should be held below one of the redds previously marked, and then the gravel should be gently stirred with a stick. The eggs, being very little heavier than water, will be washed into the net by the current, and when a few have been collected they can be examined. As a rule, when they have not been fertilised they will be white or opaque. This is not always so; only, even if they are clear when disturbed, they will soon turn white. After lying in the gravel for six weeks, the eyes of the embryo—two little black specks—should be plainly visible, and if the egg is held between the first finger and the thumb against the light the embryo will be seen. If it is not, it may be safely concluded that the egg has not been impregnated. Several redds should be sampled; but do not disturb them too much—just enough to get to know how things are. It must not be supposed, if one or two eggs are

unfertilised, that there has been no mate for the female at spawning time, because a very large percentage of eggs in every redd are always unfertilised ; but if no eyed ova are found it is probable that the female was alone when she deposited them. A long series of observations, made yearly on the spawning beds of trout, leads me to believe that only amid exceptionally favourable circumstances more than 10 per cent of the eggs are fertilised.

Owing to the improved system of land drainage, many streams in which trout spawn are either very short of water or in heavy flood. The conditions which in the old days would have been considered normal now only last for a very short time. When a fresh is falling, the stream will run clear and full for a few hours ; but it soon regains the level which may be called normal to-day—that is, very low. I speak of the upper waters of a stream in hilly country.

This state of affairs means that the

NEED FOR KNOWLEDGE 15

trout are sometimes prevented from getting to the spawning grounds and have to wait till a flood arrives. When this comes it is sudden and fierce; but the fish run up, and, being already late, spawn without delay. The fertilisation of the eggs in a swirling, raging torrent is a matter of the merest chance, as is their successful depositing in the gravel.

If a careful examination of the eggs collected in the net reveals the fact that each redd contains some eyed ova, they should be further examined as to their shape. If the gravel in which they have been deposited is too large and coarse, many of the eggs will be flat-sided or wedge-shaped, and these, though they may contain embryos, are wasters, because when they hatch it will be found that the alevins are deformed. The eggs should be perfectly round. If they have been pressed out of shape the growth of the embryos will have been retarded wherever there has been pressure, and the result inevitably is

deformity. To give an idea of how necessary it is to have a knowledge of the condition of things on the spawning grounds, I may mention that in one stream which I examined very carefully I found that only one batch of eggs in every seventeen had been fertilised, and that when there had been fertilisation it only amounted to about 8 per cent of the eggs. From many redds I managed to collect 500 eyed ova, which were taken home and laid down in a hatchery. It was then noticed that most of them were mis-shaped, some having been pressed by the stones till they were actually wedge-shaped. During the time they were in the hatchery the loss was not more than one per cent, and when they hatched out I noticed that a great many of the alevins were deformed. Most of these had the spine turned up at right angles to the body, about half-way down the back. These soon began to die, and the net result from 500 eggs was 150 magnificent fry. This little lot represented the fish

NEED FOR KNOWLEDGE 17

intended by Nature to battle with the difficulties and dangers of life. They were splendid little fellows. All did well, and were liberated when about two inches long.

When the spawning has taken place satisfactorily and the eggs in the redds have been examined later, the next development of importance is the hatching out. The time of incubation varies according to the temperature of the water, and its range is very great. In a stream—whose temperature is affected by the atmosphere only—the eggs are sometimes 120 days before they hatch, but in streams fed by warm springs they may take as short a time as 40 days. In water with a mean winter temperature of 40 deg. Fahr., ova will hatch off after about 100 days. If just at the hatching time a frost should set in and the temperature of the water fall to 33 deg. or 34 deg., hatching will be postponed till the frost breaks. I once had a batch of 20,000 ova, half of which had hatched off when

a keen frost set in, and the temperature of the water dropped from 44 deg. to 34 deg. The frost held for a fortnight, and during that time not another egg hatched; but when it broke there came a mild rain, which sent the temperature up rapidly, and the whole lot hatched off in a few hours. It is a good plan to keep a thermometer in the stream, so that you may be able to form some idea of the time the alevins will emerge from the egg, for during this stage they need very careful protection. The alevins are helpless creatures, almost the only thing about them which is perfect being the eye. Their mouth is only rudimentary, as are also their fins, and their movements are handicapped by the umbilical sac, which supplies them with nourishment for several weeks till they are fully developed little trout ready to feed on their own account.

The alevins have a fatal propensity for collecting together in the shelter of some stone, where they lie packed, often several

NEED FOR KNOWLEDGE 19

hundreds in a bunch ; and when in this condition they form an easy prey for any of the many creatures which consider them a *bonne bouche*. During the three to six weeks when the alevins are thus lying helpless, the shallows should be carefully watched, for all sorts of creatures, which never take fish at other times, and many that do, are ready to feed on them. Their worst enemy in most places is the common farmyard duck. The damage these birds do on a trout stream is incalculable. One duck will gobble up a few hundred alevins in five minutes and then swim off to hunt for more. Water-hens, grebes, water-ousels, kingfishers, and even robins and wagtails, will take the alevins if the water is shallow enough, as it often is. I once watched a robin take seven in five minutes. The various creatures in the water do not do the alevins much damage, because, as a rule, it is so cold at this time that they are either hibernating or very sluggish ; but in a stream fed by

warm springs the destruction from beetles, caddis worms, eels, etc., is very great, and it is indeed a mystery how any manage to survive at all.

The position of the spawning beds on any stream is important, for if there is no suitable ground in the head waters the fish will spawn on gravelly beds in the pools, and when they do this the fry are devoured in the spring-time by the larger fish. It is a provision of Nature that the trout shall migrate to the head waters of a stream at spawning time to deposit their eggs in the small runners, and then drop back to deeper waters, for these runners form a safer nursery than could be found in the main stream. The fry do not, as a rule, begin to drop down stream till May or June, and by that time they have acquired much wisdom, and are fairly well able to look after themselves.

Where there are no natural spawning grounds in the runners and tributaries they can easily be made. The best way to do this is to make a long cut from four

NEED FOR KNOWLEDGE 21

to six feet wide, parallel to the stream, and cover the bottom with a foot or 18 inches of gravel about the size of a pea. Water can be drawn from the stream in such a way that it is always under control, and the outlet from this artificial bed must be allowed to enter the stream lower down. At spawning time a good current should be turned over any new spawning ground, and the fish will find their way on to it.

Any one who is interested in the work will derive considerable pleasure from the sight of a number of spawning fish on ground which he has prepared for them. There are many beds of this kind, working successfully, up and down the country; and when one considers that the only things needful are good water, a little labour to prepare the cut, and some suitable gravel, it is a wonder there are not more.

CHAPTER II

BALANCE OF THE SEXES

An Overlooked Consideration—Nature's Waste—Male Trout rasher than Females—The Cannibal Tendency—Scientific Investigations—Important Discoveries—Dearth of Young Males—The Remedy.

BEFORE proceeding to follow up the life-history of the fry, it will be well to consider a point which is too often overlooked, and has caused a great deal of trouble to many people who have watched the stock of trout in their waters getting less year after year without being able to find the cause.

It is of the utmost importance that the balance of the sexes in the stock should be maintained. It is thought by most people that Nature will look after this, and so she will in her own way,

where the interference of man does not upset her plans. It cannot be too often or too strongly pointed out that Nature's methods, though excellent for their purpose, must not be relied upon to produce a stock of fish which will stand the continual drain of many seasons' constant fishing. When man steps in and takes toll of the mature fish, he must also take pains to lessen the waste which occurs during the earlier stages of their existence. Let me repeat that Nature deliberately sets to work to provide for a heavy percentage of loss from the time the eggs are laid by the parent fish, in order to prevent the overstocking of the waters. If, added to this wholesale destruction, we have a persistent drain on the mature fish at the hands of man, no stock, however heavy, can maintain its numbers for long. It is necessary not only to protect, but also to cultivate. There is abundance of material to work on if attention is given to the frustration of Nature's wasting processes.

Anglers who carefully consider the number of trout which it is safe for them to take from a certain water have, ever since trout fishing became a popular sport, taken it for granted—if, indeed, they ever thought of the matter—that their catch will be, roughly, about half male and half female. This is by no means the case, because the young, lusty, well-grown males are far more readily taken on the fly than the more sedate and quieter females. As a rough estimate—which, however, has been arrived at by considerable experience—I should say that the catch for a season on any water which is fished with the fly only would average about 75 per cent of males. This is likely to be disastrous to the future stock.

In many trout streams where the feeding is abundant and the fish run large, there is already a tendency towards a scarcity of male fish, for it has been observed that large, well-nourished females produce a larger percentage of

female offspring than male. On the other hand, where the feeding is poor—as in many of our mountain streams—the female fish are badly nourished and small, and produce a larger percentage of male offspring than female. Where there is a fierce fight for existence owing to a scanty food supply, the percentage of fry which live to maturity is mostly male. This would seem to be Nature's way of preventing too large a stock of fish in waters which do not contain sufficient food to support them.

Where males are scarce owing to over-fishing with the fly, it will be found that those which do duty on the spawning beds are mostly old and worthless, and have taken to living in holes and dark corners, where they lurk in wait for smaller fish. The cannibal tendency in all trout becomes much more developed as they grow older, and when they have once taken to regular feeding on smaller trout they seldom or never rise to the fly; consequently, they remain unmolested till

they die, and are a continual source of loss to the river. As breeders they are very inferior to younger fish, and by means of their abnormally developed jaw they are frequently able to inflict severe wounds and drive away the younger males. They fight fiercely at spawning time, and any one who has had an opportunity of handling wild spawners will have noticed how many of the younger males are wounded, often so that they cannot recover.

In a certain lake of considerable extent the trout fishing had been falling off year after year. There was no apparent cause for this; but it became quite clear that unless some steps were taken there would soon be no trout fishing at all. The few trout which remained were big fellows, and the feeding in the lake was all that could be desired. It was resolved to erect a small hatchery, collect the ova from the native fish in the autumn, hatch these out, and turn them back into the lake as fry, thus saving a great deal of

BALANCE OF THE SEXES 27

the waste which goes on among the eggs under natural conditions. There was only one stream feeding the lake which was of any importance : so we decided to keep a watch on this and net the spawners off the beds when they ran up to spawn. As the time drew near we watched unceasingly. Night after night, with a horse and trap loaded with fish carriers, and two men to work the net, I patrolled the stream. The fish were late that season, owing to scarcity of water, and for some time our watch was unavailing. The rain came early one Sunday morning, and at dawn on Monday we were out hunting for spawners. When the first shallows had been netted we knew that the fates had been unkind, for we took three fish which had spawned on Sunday night. We worked away, however, and got a few unspawned fish, and for several days we continued to get odd ones ; but the bulk of the fish had spawned directly they came up—they had been waiting nearly three weeks for water. Only a

few thousand eggs were taken altogether, at a considerable expenditure of labour and money. The hatchery had to be filled with eggs which were purchased at a distance. About the end of January I went out one day to try and collect a few eggs from the redds. I took a fine muslin net on a frame, and two jugs. After carefully stirring up a redd, I managed to collect a few eggs in the net. I was amazed to find that redd after redd contained only infertile eggs. These were carefully examined, especially those which had not turned opaque; but there was no trace of an embryo in them. Out of many redds examined, only a very few contained eyed ova, and of these we managed to collect a small quantity. The presence of so many redds with infertile ova remained a mystery which it took several seasons to solve. In order that there might be no chance of missing the spawners the following year (1900), I built a trap near the lake, so as to stop them as they ran up; but so heavy a

BALANCE OF THE SEXES 29

flood came down that I got only ten or a dozen fish, and of these only three were males, and they were great, ugly, old trout with long, hooked jaws. The fish were spawned by hand, and the eggs were all good, 98 per cent eventually hatching off.

In 1901 my arrangements were more complete, and I managed to catch every fish that came up. I was surprised to find how few there were—not more than sixty, all told, and of these only five were males! I began now to understand the scarcity of fertile eggs found in 1899, and, had I not been able to draw on my own stock of fish, nearly all the eggs taken would have been wasted. The males this year, too, were veterans, ragged and torn; we had come across no young trout, with the exception of three or four female fish.

Here we were confronted by a startling fact. The race of trout was dwindling owing to the balance between the sexes having broken down. Every one said

there used to be plenty of trout, and the natives told tales of the fish they saw each season on the spawning beds ; but no one could account for the falling-off in numbers. All sorts of reasons were suggested ; but here it was demonstrated clearly that if all other ills that trout are heir to were eliminated, the decrease would continue slowly, unless Nature restored the balance, which in this case of a breed of fish so far played out would not be likely.

The spawning season of 1902 was eagerly looked for. Now we might see some of the fish turned in as fry in 1899 coming back to spawn, and great was the excitement when we found that the three - year - olds outnumbered the old stagers considerably. For some reason or other, there were more large fish than in previous years ; but the shortness of males was even more striking, and without the young stock we should have had to waste much ova. As nearly as I could estimate it, there was only one male to

seventeen females among the old stagers. It was interesting, too, to find that we could easily recognise the males again by some scar or other mark which had been noted the previous year.

It is evident that no amount of preserving would ever have restored the fishing in this lake. Things would have gone from bad to worse, and all sorts of causes but the right one would have been suggested to account for the failure. Although in the hands of the fish-culturist things are worked differently, in a state of Nature a male fish is of service to one female only, so that, unless their numbers are fairly equal, there is great waste.

There are in this country many heavily-fished waters where the balance of the sexes has already been broken down, and, though I say it reluctantly, the truth must be told—fly-fishing is about the worst method by which fish can be taken, because, as already stated, the young and vigorous males are more easily caught, rising more freely than

females. Where there is a size limit in a heavily-fished water, the male fish are represented by old pirates on the one hand, which have long ceased to rise to the fly, and young, immature males on the other, so that not only are many eggs wasted, but also those which are fertilised are not of the best quality. A male trout is at its best for breeding purposes from four to seven years of age, and during that time he is a fine, vigorous, sporting fish, rising freely to the fly. After seven years he begins to fall off in condition, to become a bottom feeder and a cannibal, and is altogether useless and harmful to the river. Such fish should be destroyed, and the best way to do this is to allow a certain amount of worm-fishing. Restrict the use of worm to competent hands, by all means; but occasional bait-fishing is necessary, and any one who has studied any given piece of water will know the places to angle for the undesirable cannibal. The only way, apart from stocking, to counteract

BALANCE OF THE SEXES 33

the capture of the valuable breeding males is to see that, as far as possible, every egg has a chance of hatching, and every fry a fair run for its life. If this is done, I do not think that any reasonable amount of fishing can ever depopulate a water.

CHAPTER III

THE FRY

Enemies to be watched—Tit-bits for the Fry—How Nature can be helped—Swamps, Ditches, and Ponds—Poisonous Gases—Effects of Flood—Water Plants—Importance of Head Waters—Ponds overflowing into Stream—Valuable Plants.

If the spawning beds have been sufficient in area and clean, and if the alevins have been protected from ducks and other enemies, there will be a good crop of healthy young fry in the streams. As soon as the umbilical sac has been absorbed, the young fish scatter and take up positions which are advantageous for feeding purposes. They prefer fairly rapid shallow water to the quieter and more sluggish stretches, and they are healthier and stronger when they have to hold their own against the current.

Their food at this time is necessarily minute, and consists of *Daphnia*, *Cyclops*, young *Gammari*, and small mollusca, together with the larvæ of many kinds of flies.

When safely past the alevin stage, there should be no loss among them except from accident. In a state of nature, disease does not touch them at this age, and if their environment is a favourable one their growth is rapid. Great care should be taken to protect them from enemies. Two of the most dangerous and harmful which can easily be observed are the kingfisher and the dabchick. There are others in the water which are more destructive later; but at this time (March and April) the fry have very few dangers to fear when on the shallows of the smaller streams. As the season advances, and the temperature of the water rises, their arch-enemy, the eel, begins to be lively, and he is a voracious and untiring enemy, always ready for a meal. The larger trout, too, especially

in waters where food is scarce or late in making its appearance, destroy a considerable number of fry ; but they do not, as a rule, frequent the small runners.

The most important question to consider with regard to the fry is their food supply. This has been sadly diminished of late years in many places in consequence of the draining of swamps and ponds where it was produced.

The streams in which the young fish spend the first six months of their life, although providing a certain amount of food, do not produce the most valuable kinds. These are bred in more stagnant waters, which either have small outlets running into the streams or periodically overflow after rain. From these ponds and swampy places come the *Daphnia* and the *Cyclops*, two creatures which, though exceedingly prolific and invaluable as trout food, do not thrive or multiply to any great extent in swiftly-running water. The fresh-water shrimp, which is so much sought after by trout later, is

too large and tough for the fry to tackle, and until the temperature of the water rises as warmer weather comes, there are no young ones about. The same thing applies to mollusca. The larvæ of flies are usually plentiful in the gravel and under stones ; but even these are supplied in greater abundance by the stagnant pools and sluggish backwaters.

Nature's method with regard to this food supply is most interesting and instructive. It is well worth the careful consideration of those who wish to improve their stock of fish. When once it is understood, man can step in and help things along a little, so that great benefit may be derived. It is interesting to note how again and again we come face to face with the fact that Nature, with lavish hand and seeming carelessness of waste, outlines the course to be taken, but leaves man to adjust the details. He who studies closely her methods and weighs carefully the relative values of each move in the game will be able to

increase the yield a hundredfold; but unless a careful study has been made, and the whole process is understood from start to finish, man's meddling will end in disaster. There is a definite reason for each fact we come across, and it is astonishing to find what important issues it leads to.

The neglected swamp, the stagnant ditch, and the weed-filled pond, all of which are utterly unsuitable for the requirements of a trout water, are made to play a most important part. They are the breeding grounds of the aquatic life which forms the most valuable food for the trout. The water they contain is foul and poisonous, and no trout could live in it for twelve hours, but it produces in large numbers many creatures which in the purer waters of the streams could never be so abundant. Many of these nurseries of insect life contain water so charged with carbonic acid and other gases that it would be a serious danger to the fish if they were suddenly run off

into the streams : so Nature, with a wise knowledge of the best methods, sends plentiful rains and causes them to overflow. In this way two things are accomplished : the foul water is diluted, and a large supply of food is carried to the streams where the trout are waiting for it.

Now we come to an important point. These natural supplies are only periodical ; but the trout must have a constant supply of food, and in order to accomplish this it is well to see that the streams contain an abundance of aquatic vegetation in which the creatures may take refuge.

There are very many streams in the country where, after a "fresh," when the stagnant places have given up their food supply, the trout become absolutely gorged. When the water subsides they begin to get hungry again ; but their supply has gone. Such streams are barren and weedless. Often the very stones are polished by a fresh so that no living thing can adhere to them, and a long dry spell means semi-starvation to the trout.

No stream is so swift and barren that this cannot be remedied. There are always the little backwaters where sediment is deposited and banks composed of soil where plants will grow, and in such a stream no corner that will hold aquatic vegetation should be neglected. Wherever there are water plants you will find all sorts of life which is of value as trout food, and the creatures which but for its existence would have been swept away by floods will find a refuge there, and during dry spells of weather they will furnish a steady supply of food to the trout in the stream.

It will be apparent that the higher up a stream you go the scantier is the food supply from outside sources, just as the nearer you get to the source of a river the smaller is the volume of water. As the head waters of any stream form the most valuable nurseries for the fry, it is important to see that there is an adequate food supply. A very little care and trouble will make a marvellous difference

to them, and, of course, to the stock in the whole stream.

In the first place, it would be well to see that there are plenty of ponds which overflow into the stream. It has been the custom of late years to drain all such places or to fill them up ; but unless there is a very definite reason for doing so it is a mistake as far as the fish in the stream are concerned. It is not difficult to make a few ponds in waste places, and it is well worth while, for quite a small pool will produce an enormous amount of insect food. These ponds need never be an eyesore : they can be planted with water-lilies and bulrushes, and, indeed, made into an aquatic garden, which is a pleasing addition to the landscape. Remember that every pond which overflows into a trout stream and which is drained or filled up is a loss, and every one which is made, enlarged, or improved is a gain. No little ditch is too insignificant to be of value.

With regard to the water plants in the

stream itself, it should be pointed out that there are some kinds which are of much greater value than others. For the head waters of any trout stream there is no plant known to fishcultrists of such value as the common watercress. Perhaps next comes *Callitriche verna*, and then a host of marginal plants, such as *Veronica beccabunga* and *Myosotis aquaticus*.

It may seem to some people unnecessary to bother about all these things if the trout in the lower reaches are large and well fed; but they must also ask whether they are plentiful. The lower reaches of almost any stream contain a very fair amount of natural food for the fish; but it does not follow that the head waters do. The point I wish to bring out strongly is this: That it is of the utmost importance that the head waters should be attended to, so that they may provide abundant food for the fry. If the neighbourhood in which a young hungry trout finds himself is destitute of food, he will drop down-stream, and when

he arrives in the middle or lower reaches he is snapped up by the larger fish. If the fry have plenty of feeding, they will remain in the upper reaches till they are sufficiently well grown to look after themselves; otherwise they will be lost.

Year by year the food supply is getting less in the head waters of many trout streams. Ditches are being cleaned out; land is being better drained; flood water, which used to cause a welcome spate lasting several days, now runs off in a few hours and sweeps the streams clean. Unless all these contrary influences are intelligently counteracted, their effect on the fishing will not be long in making itself felt. There is every inducement to be on the look-out, and every scrap of care bestowed on a stream will bring its own reward. Look around and see what the moorland and the waste places produce. Nature is at work there and doing her best, and even on good soil the value of her crop is small compared with what man can accomplish

when he takes her into partnership. It is precisely so with streams and lakes. Nature at her very best cannot do what man can accomplish with her aid ; but man must remember that she is the senior partner, with all the knowledge, all the capital, and most of the directing power. He must follow her directions carefully and conscientiously, always finding out the meaning of this or that, and passing nothing by which is not understood.

CHAPTER IV

POISON AND OTHER TROUBLES

Natural Pollutions—Their Subtle Action—Three Sources of Evil—Methods of Detection—The Deadly Shag-num Moss—Decaying Matter—Marsh Gas—When the Fry drop down stream—Their Enemies: Eels, Pike, and Perch.

It is often assumed that the only modes of pollution which seriously affect a trout water are caused by foreign substances which are the result of man's industry or enterprise on the land. This is not the case. There are many modes of natural pollution which are detrimental. Even as a district which is invaded by the smoke of some expanding town begins to show signs of its presence in the atmosphere, by the disappearance of some of the more delicate forms of plant life—notably lichens—long before the smoke

itself is visible, so a stream may be seriously affected by pollution without any strikingly alarming symptoms being visible. Long before pollution has become so bad that trout are killed, some of the delicate creatures which form their food supply perish, and the very first to be affected are those which nourish the fry during the first two months after they have passed the alevin stage.

It is unnecessary for me to write of unnatural pollution—the remedy for this is obvious;—but natural pollution is a matter which must be carefully studied and understood. Bear in mind that the fry are in the shallow streams which contain a comparatively small volume of water for three months or more, and you will see how easily pollution may affect them.

There are three ways in which the water may be polluted naturally: (1) by springs discharging water containing some deleterious property; (2) by water draining from some impure source; (3) by the

POISON & OTHER TROUBLES 47

sudden disturbance of a mass of mud and decaying vegetable matter, which may be caused by a heavy shower of rain and sudden spate. The first of these causes of pollution is perhaps the most serious ; the second is the most difficult to deal with ; while the third, though bad enough to be guarded against, is usually temporary, cured by the rain which caused it if a sufficient fall occurs.

There is no need for a careful analysis of the water. All doubt as to its fitness can be determined in a very simple way, and as a rule even the worst cases can be dealt with so as to leave the water in a wholesome condition. If you know of a spring which discharges into the stream, examine the state of the runner which it makes. If neither insect life of any kind nor any aquatic plant life can be found, the water should be regarded with suspicion, but not necessarily condemned. Test it further by planting some water-plants in it, which are harbouring shrimps, larvæ, and mollusca. Be very careful not

to remove these living creatures, and examine the plants in about a fortnight's time. If you find the shrimps, mollusca, and larvæ have disappeared, it will be well to make a further and final test. Make a small pool, which will be fed by the spring in question, and in this plant, as before, a good supply of water-plants, and see that they are harbouring abundant life. If, after a few weeks, the pool is found to be barren and destitute of aquatic insect or mollusc, the water must be condemned.

As an instance of how successfully spring water which will not support life can often be dealt with, I may mention the following facts. On a certain estate there were two powerful springs, both coming up out of a limestone formation, and the water in each one was as clear as crystal, so that the fine sand disturbed by the current as it came out of the earth could be seen at a depth of three feet to be continually in motion, reminding one of a miniature volcano. One of these

POISON & OTHER TROUBLES 49

springs was tapped and turned through a series of ponds in which were placed trout of various ages. They did well and thrived exceedingly. A year or two after this it was thought well to make the other spring—apparently exactly the same as the one already in use—do duty in the same way. A series of ponds was made and the water turned through them for a few weeks prior to the introduction of the trout. With the successful experience of the water from the other spring, this one was never doubted for a moment, and a large stock of valuable fish was turned in. Next day there were many of these lying dead on the bottom of the pond. It was thought that they had been injured in transit; but, unfortunately, subsequent events proved beyond a doubt that the water was unsuitable, and the remaining fish, now reduced to about half their number, were removed on the third day. To test further the capabilities of the pond, two dozen trout were turned in. They died within a

week. For some time the pond remained without fish, and a large stock of water-plants was planted. Next spring the raceway at the outlet of this pond was examined, and many fresh-water shrimps were found. This hopeful sign induced the experimenter to try some fish in the second pond of the series, and to his delight they seemed to thrive, though afterwards it became apparent that it was not until the water had passed through three ponds, all well stocked with water-plants, that it became thoroughly wholesome for trout.

All this goes to show that water cannot be trusted without a test, and that if it is not suitable for trout it may be improved by planting aquatic vegetation, which will absorb many injurious properties, and will, above all, give off a supply of oxygen. There are very few springs, not obviously impure, that will not be amenable to this treatment; but, on the other hand, there are very many whose water is unfit for a trout stream

POISON & OTHER TROUBLES 51

until it has been treated in the manner described.

Pollution caused by water which drains from some impure source, such as an almost stagnant pond, need only be considered dangerous when there is a constant flow in dry weather, for, as has been pointed out in a previous chapter, Nature requires such places for the growing of trout food, and her methods of carrying this to the streams in wet weather insures immunity to the fry, because the stagnant water is well diluted. Further, it very rarely happens that water which will produce the various creatures on which trout feed is sufficiently impure to injure the fry when it ceases to be stagnant. Thus it often happens that water running from a pond only capable of containing the lower forms of life is immediately changed when in motion, as it rapidly absorbs oxygen.

There is, unfortunately, a considerable amount of water continually finding its way into the small streams which is

absolutely poisonous from having percolated through some swamp where there is a great deal of decaying vegetable matter. Worst of all is the water which drips through a bed of sphagnum. The most promising little trout stream may be entirely ruined by the growth of large quantities of that moss near at hand. This has been demonstrated again and again.

Some years ago I knew of a small stream which was an ideal one for spawners. There were long stretches of gravel, and the water supply was regular and good. Each year many trout spawned there and then returned to the main stream. Every spring there were large quantities of healthy fry, which remained till June, and then they, too, dropped down. At the present time not a single spawner runs up, though the gravel beds look as inviting as ever, and it is over ten years since a fish of any kind was seen there at any time of the year.

POISON & OTHER TROUBLES 53

The reason for this change was for a long time a puzzle ; but eventually it was discovered. Three small ponds were made for propagating *Limnea*. These were close together ; but the water did not run from one to the other. They depended for their supply on soakage from the hill above. It was soon found that in two of the ponds the *Limnea* would not live ; in the third they did well. Into the first two the water drained through a bed of sphagnum ; the third drew its supply through gravel. I tried many experiments with the unsuccessful ponds, and tried to find some creature which would live in them. The water was beautifully clear, and I planted the bottom with quillwort and lobelia, and in each pond I put a large bunch of milfoil, and then introduced quantities of mollusca, larvæ, etc. ; but they all died. Even water-beetles either died or flew away, and it was some time before I could discover anything that the water would support. Eventually I turned in

two goldfish, and they lived there for a long time; but what they fed on I do not know. After carefully considering all the possible reasons for the uselessness of the water, I came to the conclusion that the sphagnum was to blame, and, remembering the stream which used to contain trout, I went and inspected it from source to mouth, and found that at several points neglected ditches had filled up, overflowed, and produced a thriving bed of sphagnum through which water was percolating.

Not long after this I had the poisonous properties of sphagnum brought prominently under my notice. A hatchery which had been working for years suddenly became useless owing to something in the water. This remained as clear as ever, but no sooner were eggs laid down than they began to look unhealthy, and soon died and turned white. An investigation brought to light the fact that a large sphagnum bed had formed near the source of the stream, and

for some distance the water was running through the poisonous moss. The bed was drained, and a cutting made for the water, which soon returned to its former condition.

Notwithstanding all this it will be well to point out that sphagnum moss pressed in layers to the thickness of stout felt has been used for over forty years in the packing of trout eggs for transport. It seems quite clear that the poisonous properties of the moss are to a large extent neutralised by the air, just as water containing an excessive quantity of carbonic acid gas may be rendered fit for trout by friction with the atmosphere, as in a swiftly running stream. Water in motion absorbs oxygen readily ; but where it is entirely stagnant or moving slowly the purifying process is very slow.

It was found that sphagnum, though excellent for packing eggs in for short journeys, was not satisfactory when the eggs had to remain in it for several weeks, unless a considerable air-space was

left between the layers. Nowadays eggs are usually packed in shallow trays with muslin stretched across to form a bottom—in this way ventilation is facilitated. When eggs were packed in very wet sphagnum the results were never good. There is little room for doubt that the moss absorbs a large quantity of oxygen and gives off carbonic acid gas.

All decay, whether vegetable or animal, in the water is bad. Decay means the production of carbonic acid gas, which is a deadly poison ; and the capacity of any given piece of water for maintaining trout is chiefly dependent upon the absence of that gas and the presence of an abundant supply of oxygen.

There are some kinds of aquatic plants which are very much given to decay, howsoever healthy the growing portion of the plant may be, and these should not be encouraged in or near a trout stream. Possibly the commonest example of a plant of this kind is the oval-leaved pondweed. It is to be found in stagnant

POISON & OTHER TROUBLES 57

pools, in ditches, and in the back-waters of a stream. It is of very little use as a food producer, and its long stem, with the oval, surface-floating leaf, is of rapid growth and equally rapid decay. It is a nuisance to anglers, and altogether an undesirable plant. Rushes, bulrushes, and reeds, though excellent in a lake or at the margin of a river whose volume of water is considerable, are not good plants to have in or near the smaller streams. Their roots and stems, besides producing a great deal of decaying matter, harbour all sorts of refuse, which floats in among them, such as leaves, silt, dead water weeds, and other things which should have been swept away by the current. Any one who takes the trouble to examine a bed of these plants will find the soil in which they are growing exceedingly foul, and there is nearly always an unpleasant smell. The water which lodges in a thick bed is held by the mass of stems till it becomes stagnant and rotten, frequently showing the iridescent colours on its

surface which are a sure indication of its unfitness for young trout. In their proper places these plants are of great use, but not where fry congregate. Decaying vegetation and silt, when allowed to accumulate, as they often will, in the more sluggish portions of a stream, become exceedingly dangerous. Marsh-gas is generated and escapes in the form of bubbles to the surface of the water, where it mixes with the air and passes harmlessly away. It is not generally known that this gas, which may be observed rising from the bottom of any stagnant pond, is highly inflammable; if a light is applied to the bubbles as they reach the surface they will explode with a slight report. So long as an accumulation of débris is allowed to remain undisturbed it does not seem to do any great harm; but if it is suddenly stirred up and mixed with the pure water of a small stream it will poison the fry for a considerable distance, especially if this should occur in warm weather. Cattle wading

POISON & OTHER TROUBLES 59

in a stream on a hot day will liberate large quantities of this rotting filth and send it floating off down-stream with disastrous results. A thunder shower, as before pointed out, will do the same thing. It is worth noting that when a temporary pollution of this kind occurs the fry rush for the nearest cover, and if there are plenty of water plants, such as watercress, *Callitriche verna*, milfoil, and others of a like nature at hand they will be safe, at any rate, if the pollution soon ceases and the foul water is cleared off by the current. A muddy condition of the water caused by a spate and the washings from wholesome soil is not harmful to the young fish—they rather enjoy it; but rotting beds of vegetable matter mixed with mud are very different. There have been cases where the lowering of a reservoir for cleaning purposes has destroyed every fish in a stream when the accumulation of filth at the bottom has been washed down with the current.

For the welfare of the fry keep the

streams in a clean and healthy condition, allowing only those plants to flourish which are vigorous and healthy and do not continually provide a mass of decaying vegetable matter. Plants which grow luxuriantly all spring and summer but decay in the autumn do no harm to the fish as they die down, because at the season of the year when this occurs Nature provides two neutralising agencies: the autumn spates and the low temperature of the water. Here it will be well to point out that a pollution which would be fatal to the trout in water standing at 60 deg. Fahr. would not necessarily be dangerous if it took place in water at a temperature of 40 deg. Fahr.

In shallow lakes the presence of large quantities of aquatic vegetation is a source of danger in severe weather in winter. Ice prevents the necessary contact with the atmosphere, and shuts off the supply of oxygen, absorption of which is facilitated by breezes ruffling the surface of a lake. On the other hand,

POISON & OTHER TROUBLES 61

the increased cold causes a rapid decay of vegetable matter under water, and consequently an increase in the output of carbonic acid gas. This explains why one so frequently hears of trout dying in large numbers in shallow lakes during frost.

I have written somewhat fully about the fry because I consider that it is a most important subject, and one which is almost always entirely ignored. It is impossible to have a good stock of trout in any water if the fry are not considered and given a good chance. The points to be borne in mind are—That it is most desirable that the fry should remain as long as possible in the shallow waters in which they were hatched, and that, in order that they should do this, the streams must provide food and cover and be free from pollution of every kind.

We will suppose that all the conditions up in the head waters have been favourable to the fry, and that they are now ready to begin the dangerous

journey to the deeper waters. This is at different times in different streams, but usually somewhere between April 15 and the end of May.

The fry are now well-formed, sturdy little fish, with their full markings, though perhaps the colourings will not be so bright as when they come to maturity. They are voracious feeders and keenly on the look-out for danger, but somewhat rash. As they must feed continually, their journey is done in short stages, and they usually drop down-stream tail first, travelling rather slower than the current, if this be swift, but in sluggish water darting off with their heads down-stream, bringing up after a short run in the shelter of some stone or weed bed to rest and feed before proceeding.

There are many creatures in the water which are aware of this annual migration of young trout, and know how to take advantage of it in their own way. The commonest enemies, and perhaps the

POISON & OTHER TROUBLES 63

most dangerous, of those which live in the water are eels, pike, perch, and larger trout.

The eels at this time of the year have only recently recovered from their semi-torpid state, and they are particularly hungry and exceedingly fond of young trout. They know just where to lie in wait during the daytime, and at night they hunt persistently, chiefly in the shallows.

During May eels are more easily caught (in most places) than at any other time of the year, and in every trout stream they should receive careful and persistent attention. They may be caught in large quantities in eel-baskets; but there is a better trap on the market made of fine meshed wire-netting. This trap is patented, and can be procured through any fishing tackle dealer, and I know from experience how useful it is. On one occasion I got 36 eels in one trap as the result of one night's fishing in a stream where I had been assured there

were no eels! It may be taken for granted that where there is water capable of containing eels they will be there, whether you are aware of their presence or not. The best plan is to get a trap and make sure. Every eel caught is an enemy the less for the trout fry, and for that reason alone they should be captured; but I may mention incidentally that they are worth 6d. a pound wholesale, and they will at any rate pay for the labour and expense of their capture. There are a few places in the country, as I know by experience, where, for some reason unknown to me, eels will not enter the ordinary eel trap; but I have never found a water yet where it was not possible to catch them on lines. These should be baited with earth-worms, minnows, or perch fry, and the hooks which are best suited to the purpose can be obtained from any tackle dealer at about 4d. per 100. The longer the line set and the more hooks on it the better; but the droppers should not be

POISON & OTHER TROUBLES 65

more than eighteen inches long or nearer together than six feet, or there will be trouble.

With regard to pike, it may be said that they are the very worst enemy the trout has, for pike destroy them from the fry stage right up to maturity, and a 20-lb. pike is capable of disposing of any sized trout that one is likely to come across outside Ireland. The destruction of pike in a lake is a well-nigh hopeless business unless it can be drained and all the streams feeding it well poisoned. I am continually asked how to get rid of pike in lakes; but after considerable experience of the matter I feel justified in saying that it can't be done by any method known. Their numbers may be reduced; but that is all.

On a trout stream the matter is not so bad. They can be kept down to such an extent that their depredations are not serious among the grown trout; but it is the little fellows, a year old, which make such havoc among the fry. While the

larger pike can be seen on clear days, and trapped, snared, shot, or otherwise disposed of, the smaller ones up to four inches in length are very difficult to see, and worse to catch. Where pike are found in a trout water, the only thing to do is to keep on destroying them by every known method which will not injure the trout.

Perch should never on any account be allowed in a trout water. They hunt in shoals or lie in wait spread out across the stream for the descending fry, and it is almost impossible for a small fish to escape them. They will cease to feed on any other kind of food when the fry are on the move, and you fish for them in vain with worm or minnow at such times. I have seen a shoal of several thousand perch lying in the mouth of a river which emptied into a lake, and down which trout fry were coming during the last week in May. Day after day this huge shoal remained there, and there was little chance for any small trout to get

POISON & OTHER TROUBLES 67

past it. The weather at the time was bright and clear, and the perch were in such numbers that they were quite indifferent to the presence of human beings on the bank. They would not take a bait of any kind ; but a row of small boys had considerable success snatching them with a bare hook. I spent some time watching the operations of this army, and it was a fine sight to see the ranks of fish, motionless save for the quivering of their pectoral fins, till some luckless fry would drift down, and perhaps five hundred perch would swerve in one quick flash in its direction. I never could spot the fish which secured the fry ; but when the ranks resumed their motionless formation it had always disappeared. How could it possibly escape ? By all means avoid maintaining a large stock of perch in a trout water, for their food in May and June is expensive.

CHAPTER V

ENEMIES

Cormorants—Hérons—Kingfishers—Otters.

BIRDS of various kinds are troublesome on a trout water. As far as the mature fish are concerned the cormorants are the worst enemy. These birds do not usually frequent inland waters to any great extent; but streams and lakes lying near the coast suffer heavily, and I have come across cormorants in considerable numbers as far as twenty miles from the sea. A large sheet of water, even when much farther away, will attract them, and they may be found anywhere in Scotland and Ireland; it is the comparative scarcity of large sheets of water in England that accounts for their rareness

away from the coast in that part of the kingdom.

It is hardly possible to overrate the mischief done by cormorants where trout are found. Their voracity is extraordinary, and their skill marvellous. From careful observation I believe that a cormorant is able to consume at least its own weight of fish in a day. I have seen a bird take twenty-four good-sized fish in less than four hours, and even then it only changed its feeding ground. During the spring, when the needs of a hungry family have to be considered, the daily catch must be enormous. It is fortunate, indeed, that these birds will take other and less valuable fish as readily as trout; but when they are found frequenting waters containing only varieties of salmonidae it is obvious that their needs are supplied by these fish.

A great many people who are aware that a few cormorants are continually fishing their waters have no idea how many there may be. Otherwise they

would take active steps. When once the birds have settled on the water they are not easily seen by those whose eyes are not trained to notice the movements of birds. Their black bodies are invisible to any one in a boat or on the shore of a lake, if the bird is any distance off. Only the neck and head shows plainly, and even this part of the bird will frequently be unnoticed by the angler. On the wing they are striking objects, but where the feeding is good their flight is usually confined to morning and evening. As they seldom fish in flocks, though frequently in pairs, their numbers scattered over a wide area do not make any great impression on a casual observer.

One excellent trout lake, lying about two miles from the coast, was frequented for years by cormorants before any one realised what numbers visited it daily. One evening three anglers took up a position on a small island on which stood a large dead tree. Armed with guns, they waited, and as soon as it was

dusk the birds began to arrive. Many shots were fired. Owing to the well-known hardness of the feathers of the cormorant, and to the fading light, the bag held only eleven birds; but this was sufficient to prove that the marauders were frequenting the lake in numbers hitherto unguessed at. From that time unremitting war was waged, and in a season or two the stock of trout in the lake improved in numbers considerably.

Cormorants are very hard to shoot or trap. They are exceedingly wary and cunning, and it is usually found that no method of destroying them, however successful to begin with, avails for long.

The birds nest in colonies, and this fact affords the best chance for any one who wishes to reduce their numbers. Often their nests on the cliffs are inaccessible; but usually both old birds and young can be shot during the nesting season. However horrible this may sound, it is the only way of successfully

dealing with a pest which destroys much valuable property.

The heron is usually regarded as destructive on a trout water, and there is no doubt he has earned his reputation; but his depredations are never at any time so serious as to cause anything like the amount of mischief done by the cormorant. He is handicapped in many ways, and there are frequently times when trout-fishing is out of the question for him. Much of his time is devoted to catching frogs and eels. If frogs are plentiful, he will not trouble the trout while the supply lasts. On one occasion I saw a heron almost frantic with excitement because he had discovered amongst a number of trout ponds one which was devoted to the rearing of frogs. It was in the month of June, and the frogs were hopping about on the grass. They were no larger than the kernel of a walnut; but the bird ran back and forth among them with wings partly stretched, and uttering a discordant croak every now

and then, while he picked up the frogs round his feet. The trout which were eaping near by were forgotten.

A large number of herons on any trout water is bad ; but a few are not of any serious consequence. It is easy to form an accurate idea of the number of herons frequenting a stream or lake, for they are visible and striking birds. Where pike and other coarse fish are found in a trout water, herons should not be molested. They destroy many of these fish, which they can procure more easily than trout, and I am not inclined to think they have any preference for the latter.

The presence of a heron cannot be tolerated at a set of rearing ponds. He will, if allowed to do so, continue to come day after day till he has reduced the numbers of the fish to an alarming extent ; but his opportunities where a large number of fish are crowded together in a pond are such as never occur on a stream or lake.

The kingfisher, though a tiny bird, is a

destructive one. The number of fry he is capable of taking in a short time is amazing; but usually waters frequented by kingfishers contain other fish than trout, and they are impartial in their taste. Kingfishers are seldom seen in high-lying districts; these are the home of the water-ousel. The lower reaches of a river or stream, where the water is more sluggish, or where at any rate the pools are deeper and longer, is the favourite haunt of the bird. Only now and then is one seen on a mountain stream.

It would seem that the kingfisher does not prefer a trout stream to one containing coarse fish. I know several districts where there are, not many miles apart, streams in which only trout are found, and streams in which trout, pike, perch, and minnows thrive. On the former the kingfisher is seldom seen; on the latter he is fairly common. Nevertheless, it must be admitted that when a set of fry ponds is made in any district kingfishers will come from far and near. I am

inclined to think it is the size of the fish rather than the kind which attracts him. There is little doubt that ponds containing minnows would prove as favourite haunts as those containing trout.

Not long ago I placed twelve fine minnows in a small shallow tank out of doors. These were unusually large minnows. Not many yards away were several ponds in which were many thousand young trout about an inch and a half long. Next day I went for the minnows, and on approaching the tank saw a kingfisher fly away. There were only three left. Close at hand were any number of young trout, which could have been had as easily; but apparently the minnows were just as acceptable to the kingfisher. This bird is such a beautiful creature that few people would destroy it for the sake of the few trout it takes from a stream; but in connection with rearing ponds it becomes necessary to take the life one would gladly spare if the bird could be kept off. Wire-netting

is not always feasible ; in the case of a large set of ponds it is out of the question.

Another enemy is the otter, which is much commoner than most people suppose. So cunning are otters, even in a district where they are fairly numerous they are seldom seen. It is hardly correct to say they are shy, because frequently they live close to populous districts, going and coming unsuspected by the people in the neighbourhood.

It may, I think, be safely said that wherever there is a stream or river containing fish otters will be found frequenting it at some time or other during the year ; at night they will even pass down or up a river running through a town.

In some districts they are fairly common, even though they may never be seen ; but nowhere can they be called plentiful. Except to those who have studied their habits, their presence is almost sure to be unknown. An ordinary observer would probably mistake their

footprints for those of a dog, and many of their depredations are put down to foxes. Their habits are well understood in many parts of Ireland, and the farmers lose many a duck on the rivers and bogs at night.

If an otter only killed for food things would not be so bad ; but, unfortunately, he frequently takes to killing for sport. I once gathered twenty-two trout, all over two pounds, from the grass near a well-stocked pond. Only a few of them were partially eaten. That very night an otter was caught ; next night, another ; on the third night, a third. After that it was a year or two before the pond was visited by otters again.

These animals are remarkable in many ways, and perhaps the strangest thing about them is their marvellous power of keeping out of sight. I have lived in districts where they were fairly common and kept a sharp look-out for them, but very rarely managed to catch sight of one.

Once I hunted three or four youngsters in an iris bed growing in the middle of the river. The bed was not large, and I beat it through carefully; but always when I reached the end I heard behind me the peculiar windy whistle of the otter.

On another occasion, while fishing in the dusk, I saw a duck in a flock at the other side of the river suddenly begin to flap its wings, and heard it quacking loudly, evidently in distress. The light was dim; but the duck was white, and I saw it being dragged off right before me in the open—but never saw the otter!

In 1901 I tracked an otter to an opening in a frozen lake, where its tracks ended; as there was a light covering of snow on the ice, it occurred to me that I might be able to discover where it came out. After a long hunt I found its tracks again, where a stream ran into the lake, two miles away. I cannot be certain he did not have a breathing spell somewhere on the way; but I do know

that there were only the two sets of tracks round the whole lake. Is it possible he could have taken advantage of the large air bubbles which form under the ice ?

I have never been convinced that otters do a serious amount of harm on a river. I have, at long intervals, found odd salmon which they have killed and partly eaten ; but these evidences were too rare to make much impression. That an otter runs amok in a pond well stocked with large trout is understandable ; but I am inclined to think this unfortunate tendency is not frequently exercised, for there is so little evidence against the otter on a river, and certainly they are most numerous on some of the best salmon and trout rivers in the country. I may say with the exception of heavily stocked ponds I never came across a district where it has been necessary to kill the otters on account of their fish-eating propensities ; but, on the other hand, I have known several cases of their depreda-

tions among the poultry bringing down the wrath of the farmers on their heads—this too, in a district where there were no foxes ; so there could be no mistake.

Otters are easily caught once you know their runs. They keep very much to the same path, often using one side of a river for the upward journey and the other for the downward. The best place to trap them is on a shallow where they are in the habit of landing, or in a water-course up which they are known to travel.

The most successful plan, I have found, is to use from six to a dozen good strong traps slung on one chain and laid near together across the stream in about three inches of water. When the otter gets a foot in one trap he is not long before he is caught by another, and usually he will be found with three legs fast. I never caught one with all four legs trapped. In adopting the above method ordinary strong rabbit traps may be used. If only one or two traps are

set they require to be much stronger. As a rule, any one catching an otter hears about it, especially if there are hounds in the neighbourhood. On the occasion before alluded to, when the three otters were caught, I was recommended to keep fires burning round the ponds at night to keep the wild beasts off!

CHAPTER VI

PROVIDING FOOD AND REDEEMING WASTE

Demand and Supply — Importance of Statistics — Useful Vegetation—Mollusca—What may be made of a Brook — Engineering — Mill-races — Mill-dams — Poacher's Harvest—Mountain Streams—An Example of Success.

Those who have studied a trout stream closely are aware that, as a rule, the growing fish and the mature fish are not on the feed at the same time. It sometimes happens that the result of a day's fishing is a basket of undersized trout, whereas at another time only the large mature fish are caught. It would seem that this was a provision of Nature for the protection of the young fish ; at any rate, it is a happy coincidence which tends towards their safety.

A plentiful food supply means not only

that the young trout keep to their own quarters, but also that the larger fish keep to theirs. The old stagers love to have a corner to themselves, in which they can find both bottom and surface feeding in abundance.

If the supply in the stream is scanty, the older the fish get (up to a certain point) and the larger they grow, the more widely they must forage for their food, for each season they require more nourishment. When this state of affairs exists the danger to the small fish is great, and it will be found that the older trout leave the pools in the dusk of summer evenings and pick up a meal of youngsters on the shallows.

The question of supply and demand in a trout water is one which requires the utmost care. Too much feeding is bad from an angler's point of view, for the trout get lazy and will not rise to the fly. Too little feeding means that they will be keen risers, but not large, and when they get old and cease to rise they must become

cannibals or starve. It is frequently thought that only large trout become cannibals in their old age, but this is far from being the case. Our mountain streams, which contain small, poorly-nourished fish, produce as many cannibals as, and probably more than those where the feeding is better, and, as almost the only food they can procure is small fish, they are more destructive.

To strike and maintain an exact balance between the food supply and the stock of fish is difficult, and the difficulty is increased when the fishing is haphazard, and no record is kept of the season's catch each year or the numbers of spawners on the redds in the autumn. Even if this is only done approximately it is a valuable guide. Possibly it may be thought too much trouble to keep in touch with the important facts bearing on the welfare of a trout water, and if this is so it only remains to be said that he who neglects his stock will lose it.

Of the two evils an excessive food

supply is less to be dreaded than a scanty one, because, unless there is some serious obstacle in the way, this will right itself in time, as the number of young fish which survive will be large enough to stock the water fully.

When the supply is scanty there are two ways of dealing with the water—either by reducing the number of trout, or turning special attention to the propagation of those creatures which the fish feed on. The latter way is much the more satisfactory, though perhaps the former is easier.

The nature of the stream under consideration will decide the question of ways and means. If it be a stream flowing through a district where the conditions are such that sudden and violent floods are unknown, it will be most convenient to utilise the stream itself for the work. If, on the other hand, heavy floods and swiftly-running water are the conditions periodically prevailing, it will be necessary to construct auxiliary food nurseries near

at hand. This may sound a formidable undertaking ; but it is not really so, and usually there are many places where small runners or springs, too insignificant to be of value as spawning waters, may be used.

For example, let us suppose that a flood-scoured river is winding its way along a valley, its shifting gravel beds allowing no resting-place for aquatic vegetation, or even the larvæ and mollusca which feed upon confervoid growths on the stones. The fierce tumult of the winter torrents prevents any useful growth of shrubs or trees along its banks, those which are there being stunted and barked by pounding ice. A river which is periodically scoured clean and is destitute of the delicate forms of aquatic life on which fish feed—are there trout there? Yes: thousands of them, but so small that ten average fish scarcely turn the scale at a pound! There are many such streams in the wilder portions of the country, and you may on certain days take from sixty to a hundred in an after-

noon's fishing. These homes of the fingerling are usually considered hopeless ; but in a few places the conditions have been much improved. Never can one expect to increase the size of the fish in such a stream till they rival the trout in quieter waters ; but an increase from an average of two ounces to one of a quarter of a pound, with a fair sprinkling of half-pounders, is worth trying for—is it not ? There are few streams so hopeless that this cannot be attained, and frequently, as before pointed out, with little difficulty.

Though the river itself is unruly and violent, this very fact goes to show that there are innumerable feeders which contribute to the flood, and it is these which must be made use of. Many of them dry up entirely in hot weather ; but even these, unless on loose gravel, are useful. Fortunately, food can be grown in still water, even in greater abundance than in a stream, and for this reason a very small runner will suffice.

A series of dams or pools should be made on any suitable water-course, and these should be stocked with aquatic plants. As no fish should be allowed to enter the pools, there will be no fishing, and consequently some of the most luxuriant plants can be used. Of these the best, from a food-producing point of view, are water-cress (for the margins and the runner itself), Lochleven weed, milfoil, and starwort (for the bottom of the pools). There are many other very useful plants; but a good stock of these will be all that is required.

A great quantity of life will soon make itself manifest among the plants in the pools, for Nature in a marvellous manner makes use of corners like these, producing an infinite variety of creatures which in some mysterious way appear of themselves. To supplement Nature's stock a quantity of mollusca should be turned into each pool, and the very best and most prolific kind is *Limnaeus peregra*, next in usefulness being *Planorbis* and

Pisidium. These will all multiply with exceeding rapidity, and in wet weather a continual supply will be taken to the river, where for a time those which escape the trout will find places to lodge, and in this way a certain amount of food will always be available, besides the supply from the floods.

Most useful of all foods in such a river as has been described is the fresh-water shrimp. The shrimps will thrive and multiply in the pools with the plants and the *Limnea*, and they are more able than most creatures to escape from the destruction caused by furious floods. Where the gravel is of a fair size and lies in great banks, as is usually the case in a mountain stream, they will in times of flood penetrate many feet down among the stones, and so escape from danger.

A careful study of the formation of a trout stream will reveal a number of places which may be turned to account for growing food; they are frequently waste places, producing nothing of value

in their present state. Of these, backwaters out of the main current are the most common, and here the cultivation of aquatic plants will be easy and very beneficial to the stream. Wherever the bottom of a pool is soft, it may be taken for granted that the floods will not disturb a growth of plant-life, and such places should be made to produce food.

A little experimenting on the part of those anxious to improve the food supply will result in the discovery of countless opportunities and places to be utilised which had never been noticed before. Plant-life is the secret of success in growing food, and, having due regard to the angler's requirements, no place where it is possible to cultivate this without hindering the fishing should be allowed to remain barren. It is hardly necessary to point out that in some waters the difficulty is not to produce aquatic plants, but to get rid of them. Such streams come under a different category from the type we have been discussing.

Attention has been called again and again to the wasted waters all over the country. It does not seem to occur to many people that a small stream a few feet wide, with an inch or two of water running over a stony bottom, can be of any use as a trout water; yet a few experimenters have accomplished great things under apparently unpromising conditions.

A small stream or brook will not yield much if left to itself; but every owner of such a water should carefully examine it to see whether there is not a possibility of making it do service as a supply for a dam or series of dams, or perhaps an artificial lake. The lie of the land should be studied with regard to levels. Though an unpractised eye might not see opportunities plainly apparent to the expert, a general idea may be formed and an expert can be consulted before any outlay is made.

A stream running through very level country is not easy to deal with if it is

desired to form a dam or a lake ; but, though opportunities under these conditions are not great, it is always possible to improve matters. Such a stream will not be liable to violent floods, and if the water does rise in wet weather to any great extent it will do so gently. This fact makes the work much easier than in a swift stream, where the current during the winter months would obliterate any but the most substantial work in its bed.

Even though, owing to the levels, it is not possible to raise the water in the stream to any great height, it should always be kept at its utmost depth. This can be done by a barrier placed across the stream. A wooden one is very satisfactory, if care be taken to sink it sufficiently to prevent the water working underneath. A small stream with two or three inches of water in it is not likely to afford suitable places for trout to take up their abode ; but if the depth can be increased to fourteen inches, or even a foot, it will alter things for the

better considerably. There are very few small streams which will not stand raising as much as this.

The next thing to consider is whether the banks cannot be cut away in places in order to widen the stream. Wherever there is a bend this can be done with advantage, or even if the banks are straight. Suppose the stream is three feet wide, and that here and there six feet is cut away from each bank for a few yards, a pool fifteen feet wide and a foot or eighteen inches deep is the result. It may not seem much; but it is better than the original stream, and these pools can be multiplied at will. The barrier across the stream will keep the water at the right level, and if necessary other barriers may be constructed. Even in very flat districts opportunities will be found for making the pools larger and deeper than those described; but it is astonishing what good fishing may be had in eighteen inches of water, provided there is a current.

A pool having been made, it will not do to leave the bottom bare. Cover of some kind must be provided ; if stones of a suitable shape and size can be had, these form the best and most natural cover. Draining tiles have been used with success, placed so that the water runs through them. They are unsightly ; but this objection can be got over by planting aquatic vegetation round them. The growths, of course, must be kept under control—not allowed to block the entrance.

Even of more importance than suitable cover is the presence of an abundant supply of food. We have already seen how this may be ensured.

A small stream treated in the manner described will provide good sport. If trout do not frequent the stream in any great numbers, and do not (though they probably will) collect from other places, the pools may be stocked. If there are fish about and you provide a suitable environment for them, it will not be long before they find it out.

There are hundreds of mill-races in the country, often disused, which could be made into capital trout preserves with very little trouble. They are often of considerable length and well worth paying attention to. Where a mill has been abandoned screens may be placed at each end of the race, and the supply of water regulated by sluices. In this way the fish are entirely under control, and a few hundred two-year-olds turned down will yield excellent sport.

Mill-dams are frequently neglected, unless there is a wily poacher in the neighbourhood who understands their value. To such a man they are a small gold-mine if it happens that they are supplied with water from a trout stream. In a dam food is usually more plentiful than in the stream itself, and so they form regular traps for the trout. The poacher knows this, and once or twice a year he chooses a dark night and runs the water off, collects his fish, turns the water on again, and next morning the trout are

in the market and the dam is full or filling rapidly, and no one is the wiser. It is impossible to keep up a good head of trout in any stream from which mill-races lead to dams which are treated in this way. The cleverest hands at manipulating a mill-race are the small Irish mill-owners. They get three crops in the year—trout, salmon, eels. An Irish mill-owner on a good river often makes more in this way than his mill brings him. I have seen the whole process, and am able to form a fair idea of what this sort of thing means to any river. Of course, it is illegal; but in Ireland, and to a less extent in England and Scotland, the risk of detection is slight, and the remuneration considerable. All disused mill-races should be controlled by those who have the fishing rights, and where a water-mill is still working a sharp lookout should be kept. There are many mill-owners who have nothing to do with this poaching, but frequently they wink at what is done by those in their employ.

A small stream running down a mountain side is even more difficult to deal with than one on the level. Any dams constructed would not be of great extent, and the winter floods not only make work difficult, but also bring down quantities of gravel, stones, and débris of various kinds, which would soon fill a dam if made on the main stream. There is always a chance of the lie of the land permitting a hollow near at hand to be made use of. When this is the case the stream must be tapped and a race-way cut to carry the water to the place selected. By doing this the supply can be controlled, and the débris brought down by floods passes downstream without entering the race. There are many places where water has been taken from a stream along a hillside to some suitable place for the making of a pond or lake, and the results have been very satisfactory.

It is not necessary to have a large supply of water if the pond is a fair size.

A small pond requires more running water to maintain a stock of trout than a large one, and if there is an opportunity for making a pond of an acre or more, only as much water as will keep it full will be required. The wind which ruffles the surface keeps it sweet and fresh; it provides an unfailing supply of oxygen, which is absorbed by the water. A pond sheltered from the wind by trees will not hold as heavy a stock of trout as one in the open, and if it is very much enclosed the water becomes so stagnant that trout will not thrive in it.

The only cure, short of cutting down the trees, is to turn a good current of fresh water through the pond from some neighbouring stream.

When a place has been found which will make a pond or lake by constructing a dam and diverting a water supply from a stream, it will be well to consult some one who is accustomed to this kind of work, for there have been many bad accidents owing to dams being too lightly

made. If the sheet of water under consideration requires a dam over ten feet in height and thirty yards in length, a competent engineer should be employed.

There are many places in the country where, owing to advantageous levels, waste land can be turned into a lake with very little labour and expense, and a sheet of water properly managed is of far greater value than poor land.

For this kind of work a small stream is really more satisfactory than a large one; it can be more easily controlled. In all cases where an artificial sheet of water is made and supplied from a swift mountain stream, the silt and rubbish brought down must be carefully considered. If it is not convenient to tap the stream, and the dam has to be made across its course, a small dam should be constructed at the inlet; it will form a settling pond, and the collected débris can be cleaned out periodically. I know of at least two large sheets of water,

constructed at enormous expense, which are fed by streams from the hills, and are gradually filling with stones and gravel. A comparatively small stream will, amid certain conditions, bring down many tons of stones and silt during one freshet lasting only twenty-four hours. After the break-up of a frost the amount of soil and gravel carried away by the mountain streams is enormous, if it should happen that heavy rain falls at the time.

Quite a small stream or even a tiny spring on a hillside forms an excellent source of supply for an artificial lake.

Undulating country, with fairly level stretches between the hills, usually affords more opportunities for the construction of lakes and ponds than either flat or mountainous districts. In the latter chances do not occur so often, but when they do it usually means the making of very large sheets of water.

No dam should ever be constructed

for the purpose of forming a trout lake without providing a bottom outlet, so that if necessary the water may be run off. Sometimes repairs are needed on the embankment, particularly one which has been made only a few years. An embankment well made to begin with gets stronger as it gets older, but after a few years there is nearly always a fault somewhere in a new dam,—owing to a variety of causes, chief among which is the settling of the dam itself. Where concrete of proper strength is used, there is not much fear of a leak breaking out; but one cannot be absolutely certain of this if the pressure is very great, for sometimes water finds its way through the bottom of the lake a long way from the embankment, and comes up as a spring somewhere lower down—perhaps half a mile away. With embankments holding back only ten feet of water there should not be any serious difficulty, and this depth is an excellent one for a trout preserve.

It would hardly be worth while going to the trouble of constructing a dam unless a depth of six feet or more could be assured. The water would heat up too much in summer, and become too cold in frost. On the other hand, if a powerful stream runs through a dam, four feet will do nicely. Shallow stagnant water is always hotter in summer and colder in winter than deep water ; but a stream running through tends to keep the temperature more even.

Many an estate has been improved by the addition of an artificial sheet of water, and in not a few cases the lakelet has been made to pay. The first instance of this kind came under my notice about fifteen years ago. Three embankments had been made across a sloping valley through which a small stream ran. A concrete drain up the middle of the bottom of the two lower lakes and through the embankment of the first, enabled the owner to run off any one of the three independently of the others. Each year

one was let off, and the trout sold ; then the dam was filled and stocked with fry. In this way an annual crop of three-year-old fish was ensured, and the venture was profitable.

CHAPTER VII

LAKES

Controlling the Stock—A Trap for Spawners—How to Work it—Information Gained—Saprolegnia—Risks to be Foreseen—Incubation and After—Nature's Exactions among Fry—Helping young Fish from Stream to Lake—Trout Farms.

ANY one who gives time and thought to the welfare of a trout stream will find that it is not very difficult to become acquainted with the conditions, adverse or favourable, which prevail ; and methods to be adopted for maintaining or improving these conditions are, when understood, not very difficult to undertake. Each step may be watched and the results noted with ease and accuracy. When dealing with a lake it will be found much more difficult to determine—first, the cause, and, secondly, the effect. The

conditions prevailing in a lake must be largely a matter of conjecture unless the trout are under complete control. This may strike one at first sight as being impossible. As a matter of fact, it is not, for the natural movements of the fish enable us to keep them under control to the same extent as cattle or horses on a large ranch.

When we remember that each autumn every mature trout, with the exception of a small percentage of barren or very old fish, leaves a lake to spawn in the streams which flow into it, we can see the opportunity given for taking stock.

There are a few lakes where trout appear to do fairly well which have no inlet or outlet, and where the fish spawn on gravel in the shallows. Such waters are exceptional, and difficult to deal with, and they seldom hold a large stock of fish. The conditions are abnormal, and the trout are handicapped at spawning time by the absence of running water, so necessary to the welfare of the eggs.

Generally, a lake has an inlet (often several) and an outlet. If spawning ground is scarce in the streams flowing into the lake the fish will go down-stream ; but as a rule they do not do this to any appreciable extent.

The inlet streams are the important ones, and if it is desirable to make the utmost of the angling, these should be given a good deal of attention. At a suitable place a trap should be built which will catch every spawning fish as it runs up. Usually the best site for such a trap is just where the stream enters the lake. Its construction is not very difficult ; but the method must be modified to suit the particular conditions. I have always used a large wooden tank, built into the stream, taking care that the bottom is so laid that the current cannot in flood-time work its way underneath and make a hole up which the spawning fish can run. This is a most important point. The tank is composed of a wooden floor and two wooden sides, with screens

at each end through which the stream flows. The screen at the up-stream end may be a fixture ; but it is better to have it so arranged that it may be removed when the spawning season is over. The screen at the lower end should be made in halves and hung on hinges so that it may open inwards.

When the trap is set, the two lower screens are slightly opened up-stream, so that there is an opening of about a foot between them. To this opening and inside the trap is fixed a net funnel extending from top to bottom, and about two feet into the trap, reducing the aperture to about three inches. Through this the trout will find their way when running up-stream ; but once inside they will be stopped by the upper screen—their return through the narrow opening of the net funnel is a very remote contingency. Should an odd one happen to find its way out, it would be back again in an hour or two, so strong is the instinct to travel up-stream. There are several

ways of keeping the net funnel extended ; but I found the most satisfactory was to have an iron rod hinged to the screen reaching from top to bottom, with one or two arms projecting horizontally upstream, to which the net was laced. One of these on each screen made a very satisfactory framework for the net, and they enabled one to widen or diminish the entrance to the trap at will.

Unless the tank is built sufficiently high out of the water to prevent the fish from jumping out, it is well to have movable lids. The screens are best made of wooden bars well supported by cross horizontal pieces behind. For all ordinary conditions these bars may be cut five-eighths by one inch and fixed with the narrow edge up-stream. The distance apart will, of course, depend upon the size of fish which will be caught ; but as spawning trout are usually a fair size, it will seldom be necessary to place them closer together than one inch, and in many waters an inch and a quarter will

not be too wide. Screens of this kind do not block readily, and if any rubbish should collect they are easily cleaned with a rake. A screen with a square mesh made of wire is very bad for blocking, and extremely difficult to clean, as leaves and grass cling tightly to it under the pressure of the current.

When a batch of spawners have entered the trap, after tiring themselves out by jumping at the upper screen, they will lie quiet with their noses close to the bars. During the time the fish are running they should be overhauled frequently, the ripe ones spawned and returned to the stream, the unripe ones being allowed to remain in the trap until they are ready. The question of what to do with the eggs will, of course, have been decided beforehand: they will be taken away either to a hatchery or to artificial spawning beds.

It takes two people to overhaul the fish in a trap of this kind, and the way it is done is as follows :—

Two nets must be provided, one on a square wooden frame, which just fits inside the trap, and one landing-net on an iron frame, square or oblong. When the lids have been removed the hinged screens at the lower end of the trap are closed, and the square net on the wooden frame, which is known as the stop net, is lowered perpendicularly until its lower edge is resting on the wooden bottom, care being taken to keep the sides of the frame close to the sides of the trap. The stop net is then gently worked up-stream, without letting any fish past, till it is within about four feet of the upper screen. Then, by means of wedges, it is held firmly in position. All the fish are now in the narrow partition between the stop net and the screen, and may be lifted out and sorted by means of the square landing-net. A couple of good sized tubs containing water should be placed handy, and into these the ripe females and a sufficient quantity of males may be put; the rest of the fish (unripe

females and males) may be returned to the trap below the stop net. When a sufficient number of fish have been put into the tubs they can be spawned, the eggs being taken into basins and the fish returned to the stream. Then the sorting continues; and so on till all the fish have been handled. The stop net makes a partition which keeps the sorted and the unsorted fish apart till all is finished. The eggs must be taken away and laid down in the place set apart for them, and the fish in the trap, together with any fresh arrivals, may be sorted over the next day or whenever it may be thought desirable. As a rule, every alternate day is quite often enough to go over them.

The whole business, when once in full swing, is simple and satisfactory. So far as I am aware, it has no disadvantages, and the advantages are very great. Besides the enormous saving of eggs, owing to perfect fertilisation and subsequent care, the opportunity afforded

for observation and regulation of the stock is invaluable. The operator becomes thoroughly acquainted with the condition of the fish, and gets to know many of them by sight, even if he is handling thousands of them. He can tell whether the food in the lake is sufficient; he can note any increase or decrease in numbers from year to year; he can see whether the stock of young spawners is as large as it ought to be; and, perhaps most important of all, he can deal with the old and useless males in a way which, if not strictly legal, is certainly beneficial. He can carry out the most careful and intricate experiments as to rate of growth per annum, or other important and interesting facts, by means of marks on the fish—either the usual tiny silver label or by cutting the adipose fins in certain ways. In fact, he can farm his lake with the same care and precision that he does his cattle or sheep. Another important advantage gained by this method of dealing with

the spawners is that he can vastly improve the breed by selection.

The second time the trap is overhauled, the presence of a large percentage of the fish spawned previously will show beyond all doubt that there need be no fear of the method employed scaring the fish so that another year they will not enter the trap. This possibility has been suggested frequently ; but experience shows it to be a groundless fear. The same fish go in year after year, very often on the same day ; it is no exaggeration to say that after a season or two they seem to know all about it, and submit quietly to man's dealings with them.

Spawned fish should be put into the stream above the trap, if there is no fear of poachers. Most of them will journey up to the spawning beds and deliberately go through the whole performance of making redds, etc., as though they were quite unaware of the fact that their eggs had been taken from them. When the spawning season is over the screens can

be lifted, and the spent fish will then find their way back to the lake.

There is one danger to be carefully guarded against. This is an epidemic of saprolegnia. I have never known it happen with trout in a wild state; but I have seen some gruesome times among the salmon. If an epidemic does break out, lift your screens and let the fish go; you will save more in this way than by attempting to fight it. There will nearly always be odd cases of fungus on fish which have been wounded—particularly the males; but this is not necessarily epidemic, and may be treated successfully with an application of salt. Saprolegnia is, I am satisfied, the result of disease rather than a disease itself, and when it occurs in an epidemic form it is because the fish have something else wrong with them which leaves them an easy prey to the fungus. Any healthy trout or salmon will throw off fungus caused by a wound as easily as a healthy man throws off a cold.

The successful working of a trap for spawners is not always accomplished during the first season after it is erected. It may indeed be several seasons before anything approaching perfection is arrived at. There are a great many points to consider, and, even when all dangers seem to be guarded against, experience will show weaknesses which require attention. I well remember how carefully my plans were laid, and what an amount of thought was expended over the first trap I erected ; yet the very first year a flood bored its way through underneath the structure and allowed the spawners to pass on upstream. Only a few were caught that season. The next year a long spell of heavy rains had so raised the level of the lake that if the lids had not been securely fastened they would have floated away ; once or twice the trap was under water. By the third season we had everything in thorough order, and after that no trouble was experienced.

If the screens are allowed to choke so

that the stream is dammed up, the pressure is almost sure to make a hole somewhere, and it was not until we had discarded the strong galvanised wire of which the screens were made, and substituted wooden bars, that we could rely on their not clogging with leaves.

Ice, too, must be considered. It is not likely that this will come down-stream; but a strong wind may drive it up from the lake and do much damage. A stout plank laid across the stream, and floating on the surface, fastened by short lengths of chain to the banks, is a very great protection. If the trap is not close to the lake (the most convenient place, usually), the ice will not be likely to interfere with it.

A tree washed down by a flood and charging the screen will probably burst it, and even smaller things are liable to do damage. A row of stout posts driven into the bottom of the stream a few yards above the trap is a safeguard.

Each locality will have its own particu-

lar dangers, and, as far as possible, these should be ascertained, for it is annoying to have to learn by experience how many things there are which will wreck a trap.

It is not necessary to have the trap near a hatchery, or even artificial spawning beds, for the eggs will bear moving for forty-eight hours after they have been impregnated, and they may during this time be sent off to a hatchery at some distance or moved to another locality if desired. It is, however, more convenient to have the hatchery near at hand, or to construct beds on the stream above the trap.

After successful incubation an enormous gain over Nature's methods will have already been accomplished ; but if, when the fry are hatched out, their welfare is not carefully attended to, this may be lost. Suppose you have a hatchery full of fry which are destined to improve the stock in a lake ; which is the best way to dispose of them ? In most cases the answer to this question is : Take them

up to the head waters of the stream which feeds the lake and liberate them. Though you relinquish them into Nature's somewhat merciless hands, and though there will be a considerable loss, it must be remembered that by taking charge of the spawning operations and the incubating you start with at any rate 50 per cent more fry than if these operations had been left to Nature, and it is more than likely you are 75 per cent to the good. If nothing more is done, therefore, your work will have been well worth while; but you can do much more than this if you wish.

When the small streams are destitute of fish—that is, usually from December to the middle of February—you can either place a screen at the mouth where they enter the lake or build an obstruction which will prevent the trout returning when the warm weather comes. In this way the stream is left a secure nursery for the fry until they drop down to the lake. In many of the smaller streams

which empty into lakes the entire stock of trout drop down to the deep water before the end of the year ; but in some cases only the largest fish go, and a number of half-grown trout lurk under stones and shelving banks. When this is the case it will be a good plan to net the pools as soon as the fish begin to show in the spring, and transfer them to the lake, for the fewer trout in the water which are larger than the fry the safer the fry will be. By means of a series of small traps a stream may be kept absolutely clear of large fish, and used as a nursery only. No reasonable amount of netting or other work in the stream will harm the fry.

Perhaps the most difficult task which confronts those who are anxious to improve their stock is to get the fry safely from the streams to the lake. They must make this journey themselves, and, all unsuspecting, they are sure to come to grief on the very threshold of comparative safety. Every angler familiar with trout lakes is

aware that wherever a stream enters he will find trout. If these will not rise to the fly, they will invariably take a minnow. The reason they are there is simply to be on the look-out for small trout coming down-stream. Like well-trained watch-dogs, they guard the entrance to the lake, and if they are caught to-day others will be there to-morrow. These tiny estuaries are very favourite feeding grounds, and the best positions are fought for by the larger trout. Under these circumstances even comparative safety for the fry seems impossible. At this point, where one is liable to be so perplexed, we may learn a lesson from Nature's methods. She allows a tremendous number of fry to be consumed; but she must see to it that some escape. Her favourite way of accomplishing this is by sending a discoloured flood, in which the tiny trout slip past unseen by the keen eyes of their lurking enemies. Once this well-watched barrier is passed there is plenty of room, and the fry have a chance of surviving.

The migration of the fry from the shallow streams to deeper water is a definite movement, at a definite time, and when this has been ascertained (for it varies in different localities) much may be done to safeguard them. Nature's floods are not always well timed, and are only intended to be partially effective; but it is possible with very little trouble to supplement these by artificial ones, which will sweep the fry into the clear lake in a cloud of muddy water.

A stream which has been reserved as a nursery may be dealt with in the following way, provided there is a fair amount of fall, as is usually the case. As near the lake as possible a dam should be constructed which will hold back the water and form a pool—the larger the better; but quite a small one will do. This pool must be so arranged that it has a bottom outlet which can easily be opened. The migrating fry will drop down and rest in the deeper water, so that all that is necessary is to draw the outlet and let the

pool off periodically—say every morning during the chief migration,—by letting the water go with a run it will become discoloured and carry with it quantities of fry into safety. If after this has been done a few times the bed of the stream is scoured so clean that it will not discolour the water, a barrow load or two of soil placed opposite the outlet pipe will make a cloud which will spread far out into the lake. If it can be arranged so that the pool takes twenty-four hours to fill, and is emptied every twenty-four hours, every one of the fry may be transferred safely from the stream to the lake. It will probably be found that the migration does not last more than a fortnight, usually the latter half of May or the first half of June, so that the undertaking is not such a serious matter as it might appear. An important point is to have a large outlet to the pool, so that it may run off quickly.

By the time the fry have dropped down-stream they will be nicely grown little fish, able to look after themselves if

they have any chance at all, and once in the deep waters of the lake they will not be much molested, because at that season of the year food is plentiful for the older trout, or ought to be, so that, with the exception of the hardened cannibals who guard the streams, the fish in the lake are not particularly on the hunt for fry.

Perhaps some one may ask : Why not turn the fry into the lake straight from the hatchery, and so save trouble ? The answer is that if the lake already contain trout, it is the worst plan possible. The fry at this stage are very young and helpless, without any idea of danger. They will lie about unconcernedly in the shallows or sink to the bottom if turned out in deeper water from a boat, and the first prowling enemy which comes along has them at his mercy. There are not only trout, but also eels, caddis-worms, and beetles—to say nothing of birds and other creatures—which will devour them. The fry need running water for their development and for their safety. Though

all sorts of dangers exist in a stream, they are at home there and soon on the alert; whereas turned adrift in a lake they are lost—the still water affects them badly, and they remain sluggish. Indeed, it is questionable whether fry turned into deep, still water ever do any good at all. To take them from the hatchery to the lake is to miss out a stage in their development which Nature has ordained.

With regard to rearing the fry by hand, it must be said that, except in the hands of an expert, this method is sure to prove disastrous. Fry hatched from eggs taken from wild parents are, though strong and healthy, difficult to rear on account of their inherited wildness. Only experience can teach a man to get such fry to feed, and he will be lucky indeed if he succeed in bringing 30 per cent to yearlings. Except amid exceptional circumstances, it would be cheaper to buy yearlings than to rear them. There is no reason why any one undertaking this work should not succeed eventually; but

any one undertaking to rear a quantity of fry must give his whole time to it.

I have purposely avoided, up to the present, saying anything about stocking with bought fish, for the object of these papers is to show how the natural resources may be made the most of. Many people have neither inclination nor opportunity to develop their fishings in this way, and for these there is always the fish-culturist to fall back on; he will be able to remedy deficiencies in stock—at any rate, where the depletion is caused by over-fishing. For the guidance of those who are thinking of purchasing trout to turn down, a few remarks on this subject may be useful.

There are now trout farms scattered over the country, and any intending purchaser need only look up the nearest fish-culturist's address and apply to him. It is not advisable to turn down in a northern stream or lake trout which have come from a southern water, where the conditions of temperature and feeding

are different. For this reason alone the nearest trout farm is likely to be able to supply the best trout for your water. On the other hand, though the inadvisability of turning down trout bred from heavy South-country fish into barren northern waters is obvious, it is quite safe to turn down the hardy northern trout in southern waters, particularly if the native fish are bad risers. The northern fish will for a time prove freer risers than the native ones; but before long they will fall into line with them, and become quite as sulky. The natural environment determines the size and habit of the fish in the long-run, and even their markings and other characteristics will be influenced by their surroundings, so that if not the first, at any rate the second, generation will be much the same as the indigenous trout. Even Lochlevens, perhaps the most distinct variety of British trout, will eventually become undistinguishable from others where they have been a generation or two removed

from Lochleven or some of the adjacent waters. Gillaroo trout and one or two other varieties become lost after a year or two in strange waters, so quickly do they return to the parent stock from which they spring.

CHAPTER VIII

STOCKING

Importance of Environment—Change of Blood—Mongrel Trout—Heart of the Problem: food supply—Transplanting Larvæ and other creatures—The Dangerous Minnow—Rainbow Trout—American Brook Trout.

It is never wise to stock any water without first finding out as much as possible about the particular conditions. Frequently no beneficial results have followed a considerable outlay of money on yearlings or two-year-olds. In some cases the results have been actually harmful owing to haphazard and impulsive stocking. Just as a farmer or a gardener considers the suitability of soil, climate, and a number of other things before planting his crops, so must those undertaking the improvement of a trout water

study the natural environment. A mistake often made is to buy fish from a breed which has earned itself a good name in some part of the country, without finding out if the water into which they are to be turned is in any way like the water which has produced them. It cannot be too strongly impressed upon the minds of those who cultivate their fishings that to a very large extent, if not entirely, the environment will determine the nature of the trout in any lake or stream. I do not wish it to be inferred that it is not possible to improve a breed of trout; but I do say emphatically that this can only be accomplished by having a thorough knowledge of the why and wherefore of the existing conditions, so far as the fish are concerned, and then by mixing the breed with fish which have somewhere developed into a better variety amid conditions as nearly similar as possible. There is a great deal of nonsense talked about change of blood and the buying of fish to do this from trout farms; whereas it ought to be

clearly understood that, unless the water in question is capable of maintaining the bought trout at the same standard of excellence as the breed at that particular fish farm has attained to, instead of the native breed being improved it will be injured. As a general rule, it may be said that hand-reared fish which are the young of hand-reared parents, perhaps for many generations, are of no use whatever for changing the blood, though they may considerably improve the stock of trout numerically. A very great deal of harm has been done in this country by the mixing of some of our finest breeds of *fario* with nondescript fish. If your trout are not of any particular excellence, there is no reason why they should not be mixed with other breeds; but if they are excellent trout as regards size and gameness do not on any account turn in trout merely to increase their numbers without first learning whether they are worthy and suitable.

Many fish - culturists nowadays have

stock fish which are almost, and in some cases entirely, wild, and their yearlings and two-year-olds are in ponds so arranged that the fish can procure natural food in abundance. Such trout are much more likely to do well and improve matters when turned out among wild fish than the purely hand-fed ones. The latter are well enough where it is simply desired to maintain a stock of fish for angling purposes ; but they will probably be worse than useless if a change of blood is desired. Indiscriminate stocking is disastrous to any breed of trout ; but stocking carried out with a full knowledge of the requirements of the water will invariably be successful. By indiscriminate stocking I mean turning out trout of no particular breed amongst a well-bred variety which has become scarce through excessive angling. The best thing to do amid such circumstances is to develop the natural resources, as I have endeavoured to show in previous chapters, and not to import a mongrel breed. The average mongrel

trout is not a bad fish, and is often capable of affording excellent sport, besides being hardy ; but it is a great pity to turn him into waters where trout of a recognised and excellent breed already thrive. As an extreme example I would suggest that it would be a thousand pities to introduce mongrel trout, or even pure-bred fario, into Lochleven. On that lake the right method of maintaining the stock has been adopted. The indigenous trout are spawned and their eggs cared for, so that a large percentage of Nature's waste is saved to counteract the depletion of the water through excessive angling.

Though there are a great many waters in the country where the breed of trout is of such excellence that it would be difficult to purchase fish equally well-bred, there are many streams and lakes where the indigenous trout are of such poor quality that the trashiest mongrel breed would be a vast improvement on them ; but it is always better to stock with a well-bred variety.

Nowadays fish-culturists are fully alive to the importance of breeding carefully, and any purchaser should satisfy himself as to the quality of the trout he is getting rather than trouble about the size.

No doubt it is desirable to have large trout; but you cannot get a stock of these by purchasing them. Their size and condition depend upon your water, and not upon how large they were when you bought them, and it is a fact that there are more disappointments through stocking with large trout than are caused in any other way. Would a man turn short-horns to graze on a mountain, or put Southdown sheep on the Grampians? If he did he would learn a sharp lesson. Yet a man will buy magnificent two year-old trout from a Hampshire or Surrey trout farm and turn them into a mountain tarn full of two-ounce trout, expecting to improve matters. Is it likely to be a success?

In ninety-nine cases out of a hundred,

when people talk about a change of blood being beneficial among wild trout, it will be found that an improvement in their environment will have more satisfactory results.

Given a fairly good breed of wild trout, even though they are small, an intelligent and careful man should not have much difficulty in improving both their quality and their numbers. The whole question of quality hinges on one important point—the food supply. This is a study in itself. The requirements will vary according to temperature, geological formation of the bottom of the lake and surrounding country, the depth of water and nature of the bottom—whether it is soft or hard, weedy or bare.

Let us consider a typical lake containing a fair stock of trout averaging from a quarter to half a pound. Their numbers have been increased by means of a trap for the spawners, and the laying down of the eggs in artificial spawning beds; but their size and quality have

deteriorated since their numbers increased. A careful consideration of these facts leads one to suppose the food supply to be inadequate to the maintenance of a large stock. What is to be done? The first step is to examine the contents of the stomachs of many fish and make a note of the various items which go to make up the feeding of the trout. It will be found that, whatever the trout are feeding on, the bulk of their food is comprised of three or four kinds, with a dozen or two rarer specimens. The next thing to find out is whether the creatures which are forming their chief diet are plentiful, and, if so, whether they are of such a kind as to produce large, well-flavoured trout. As the trout are not large, it will surely be found that these creatures are scarce. The next question is: What conditions are favourable for their production in large numbers, and what do they feed on? Trout food cannot be plentiful unless it in turn has plenty of food: so this must be seen to as

well. Next, are the creatures on which the trout have been feeding prolific? If not, the question arises: Would it not be well to introduce a prolific kind of food, and the necessary plant life for it to thrive on if not already plentiful? Having regard to the fact that the trout were never very large, and that they have been falling off in size since their numbers increased, you will probably find it advisable to introduce fresh varieties of food which reproduce themselves abundantly. The most satisfactory kind of food for the angler to turn his attention to is the larvæ of various flies. These should be encouraged and given a good chance before turning one's attention to what may be called purely bottom feeding. As the trout eggs are carefully looked after, there will be no disadvantage in introducing large quantities of the various forms of caddis-fly larvæ. These are most satisfactory, as they are hardy and thrive in most waters, producing during the summer months a large crop

of flies which are eagerly taken by the trout.

In introducing larvæ into any water it will be found that the geological formation of the neighbourhood will determine to a large extent not only the kinds that will thrive there, but also the rate at which they will increase. The temperature of the water is another very important point, and in collecting larvæ of various kinds to turn down it will be well to procure them from lakes and streams where the conditions are as nearly as possible the same as those in the lake under treatment. Certain plants will thrive in certain districts and not in others. So it is with flies; yet it must be borne in mind that, even as many plants will thrive in places where they are not indigenous, so will many creatures useful as trout food. It is quite safe to turn down any kind of larvæ into a water, though perhaps an exception might be made in the case of the dragon-fly.

Never turn down any creature likely

to destroy other creatures which are of value as a food for the fish ; and do not turn down very prolific creatures which will encourage the trout to become bottom feeders, except where food is very scanty and the water unusually barren.

Water-beetles of various kinds are, from a sporting point of view, the next best food to flies, and some of these—the *Corixa*, for example—are extremely prolific.

Fresh-water shrimps and various kinds of mollusca are excellent food and amazingly prolific ; but if other food is plentiful they are better avoided, as there is no doubt they tend to make bottom feeders, though it must be said in their favour that they immensely improve the quality of the trout as a table fish. In all waters where food is scarce and difficult to cultivate, the shrimps and shell-fish are invaluable, and in such waters the trout will keep them under sufficiently to prevent any enormous stock being pro-

duced, which might, and probably would, make them entirely bottom feeders. To make sure that your trout will rise freely, provide them with an abundant fly diet, and see that the stock is sufficiently heavy to keep down any undue amount of bottom feeding. Trout that are well fed and not overfed usually rise freely, whatever food they are accustomed to.

The worst kind of food to introduce into a lake is the kind that consumes creatures which are of value to young trout, and of this class I am inclined to think the minnow is the worst example. There are many fine sheets of water in this country which have been ruined by the introduction of minnows. Scotland has suffered very much in this way, for a few years ago some one started the idea that the simplest way to increase the size of trout in the hill lochs was to turn down some minnows. In many places this was done with disastrous results. Lakes which used to yield fine baskets of trout are now useless sheets of water,

crammed with minnows, and having a few large trout which never rise.

Minnows destroy the food of the trout fry; they are very prolific, and in waters which really suit them they will almost take charge. I know there are many lakes where trout and minnows live happily together, and the latter do not increase unduly; but when introduced into waters where there are none, they seem to multiply beyond all reason. Possibly this state of affairs will improve in time, owing to the minnow food giving out; but this means a scarcity for the fry.

If you would successfully stock a lake so that its yield is in every way satisfactory, and have not time to go into the matter thoroughly, it will always be safest to take whatever fish-culturist you buy from into your confidence, and let him find out what fish are best suited to the water. He, as an expert, is soon able to see how things are, and will send trout which will give satisfaction. A mere order for trout of a certain size is not

giving the lake, the fish-culturist, or the trout, a fair chance. It is not wise to treat the stocking of your waters as you would the stocking of your larder. One larder is much the same as another, depending chiefly on the means of its owner; but the stocking of a lake or a stream is a matter for careful study and individual attention.

The Rainbow trout, introduced into this country from America some years ago, created excitement in angling circles. Fish-culturists, too, were enthusiastic about them. A few voices were lifted in warning, but the success of the fish itself from a sporting point of view almost silenced the cautious ones. That this fish was a brilliant success, hardy, free-rising, and game, no one who had tried them could deny; but, in spite of all its fair promise, it must be classed as a failure so far as the majority of lakes and streams in Great Britain and Ireland are concerned.

Now that we have abundant facts to

found our judgment on, culled from a wide area, we are able to understand why this splendid fish is of little use to anglers.

It may be said that in all its habits and instincts it is an exaggerated fario. It has hardness, it is a keen feeder, a free riser, and game, of extraordinarily rapid growth; but it has a tendency after two years of age to stop rising, a strong tendency towards cannibalism, and a strong migratory instinct. Every one of these characteristics is shared by the indigenous trout, but to a much smaller extent. In comparison we might say of the fario that it is moderately hardy, a fairly keen feeder, a free riser, and a game fish of rapid growth amid favourable conditions, with a tendency after some years to rise less freely, which ultimately ends in non-rising habits, a tendency towards cannibalism, which grows stronger as the instinct to rise to the fly grows weaker, and a latent migratory instinct.

Not only do these descriptions of the two fish tally, but also all that has been

said of the fario applies to the Rainbow with regard to cultivation, stocking, etc., if the exaggerated character of the fish is continually borne in mind.

There is, after all, nothing very strange in the fact that after two years of age, or at the latest three, Rainbows cease to rise and become bottom feeders. At that age they have grown to a size which fario in the same water would not attain in double the time or more. Their keen feeding habits would alone account for their migratory instinct, even if there were no other way of accounting for it. When they have culled the cream of the feeding in any water (and it does not take such voracious fish long to do this) they make off if they can to find fresh ground. Once they arrive in salt water the food supply is inexhaustible, and they have no inclination to return. What becomes of them it is hard to say ; but I am convinced that if they returned to fresh water for a period, no angler would be able to tell them from salmon or sea trout. I have seen in fresh

water specimens of this fish so like a sea trout in appearance that no casual observer would have noticed any difference. I do not wish to be understood as saying that this is what happens to them ; but, unless they return to fresh water at regular intervals it is most probable that they do not remain long alive. This is not the place, nor have I the knowledge necessary to enter upon a discussion of the probable origin of the Rainbow trout ; but enough has been said and written to make me think that they are not far removed from salmon, and that in a favourable environment they very likely return to the original type.

It took many years for fish-culturists and anglers to modify the favourable impressions of this fish derived from the extraordinary results obtained in the nurseries and afterwards in lakes. The first blot on its character was its migratory tendency ; but long after this had been established beyond a doubt, it was thought that in waters from which escape

was impossible it would prove a much better sporting fish than fario. Little by little evidence against the Rainbow accumulated. Owners of angling waters, at first delighted with this new variety, found that after a time the sport fell off. In most cases the first results had been so satisfactory that it was thought advisable to turn down more Rainbows. These in turn gave good sport and then disappeared. For a long time no one knew for certain what became of them; but in a few instances it was possible to let off the water in which they had been liberated. This was done. If the outlet had been well screened the fish were found there all right—huge fellows, several pounds in weight, but useless as sporting fish. Where no screen had kept them in they had vanished. This experience was the invariable result where a water stocked with Rainbows could be run off.

The reason why it took so long to realise the nature of the fish lay in the contradictory reports which came from

all over the country. In the journals devoted to sport it was not an unheard-of thing to see two letters side by side giving entirely different accounts. One would condemn the Rainbows emphatically, and one would praise them with warmth.

The following instance, which is typical of experiences all over the country, will show how this state of affairs came about.

A certain lake in a mountainous district which contained only char very hard to catch was stocked with a few thousand yearling Rainbow trout in spring. The outlet to this water was not large, and, as the lake did not rise much in wet weather, was easily screened. As it was anticipated that the Rainbows would not migrate till they were larger, the bars of the screen were not placed sufficiently close to prevent the little chaps from getting away; but they would not allow a quarter-of-a-pound fish to pass. During the rest of the summer and autumn the Rainbows were seen on calm days rising all over the

lake, and it was the opinion of those who saw them before the winter set in that they had grown considerably, but no fish were angled for. One evening in June the proprietor went down to the lake to see if he could land a fish or two, so that he might know how they were getting on. He had no thoughts of them being takable fish at that time. Arriving at the lake he found that a gentle breeze was ruffling the surface, and a rise was noted not far away. The first throw over the place was successful. A trout was hooked, and it soon became evident that it was a fish of considerable size. After a splendid fight it was brought to bank, and, to the amazement of the angler, weighed just over 2 lb. Within an hour five fish were caught, all over 2 lb., the largest being 2 lb. 11 oz. ! The experiment had proved a glorious success. These fish were only twenty-six months old, and what beauties ! The news of this catch spread like wild-fire, and the reputation of Rainbow trout was established in

that neighbourhood. Unfortunately, before the season ended there was a very marked falling off in the sport. The fish did not rise so freely and only on rare occasions. Next summer, though odd fish were seen, not one was caught, though the lake was well tried, and after that no sign of these mysterious fish was ever seen. The screen was undamaged—had never overflowed—and was sufficiently high to prevent any fish jumping over. They simply took to bottom feeding and kept to the deeper water.

One other instance. A shallow artificial lake provided with a bottom outlet and containing no fish, was stocked with Rainbow trout. The water being only from four to six feet deep and entirely stagnant, besides being surrounded by trees, it was judged advisable to turn in only a few. These were never seen again for a year, and it was thought they had died. The water was run off to make sure, and there were the fish—practically the entire number—some of them weigh-

ing four pounds ! They were only two-year-olds !

There were, and are still, some waters where Rainbows have given satisfaction and continue to do so year after year, and they have one strong claim to favour—they will thrive amazingly in water where fario could not live.

Though these fish are of such rapid growth, and though they are, compared with fario, very hardy, they are subject to mysterious diseases which occur in an epidemic form. I have more than once seen large numbers die. They are susceptible to cold, too, particularly the youngsters ; during a long frost the loss is sometimes very heavy.

Though I have been as hard to convince as any of the Rainbow enthusiasts, I am bound to admit, after experiences entailing much loss and disappointment, that they are not as a rule suitable for stocking a water in this country.

There is another species of trout which has been introduced to this country from

America—the brook trout, *S. fontinalis*. This fish, too, has fallen into disfavour. Its appearance in this country dates back to the 'seventies. There is little doubt that if it had come to us at the time when the Rainbow did, its popularity would have been greater. As it was, it had quite a “boom,” but in those days there was not the same amount of stocking done as now.

The *fontinalis* is in many ways a much more satisfactory fish than the Rainbow. Its usefulness as a sporting fish is not so quickly over. Indeed, there are a good many waters in the country where they have been giving sport for years. The migratory tendency, while not so strong as in the Rainbow, makes them undesirable for stocking streams, though I know of one or two places where they have remained for years in a water emptying into the sea at no great distance away.

I am strongly of opinion that it is a mistake to introduce either of these fish

into waters containing fario where the feeding is not particularly abundant. They are such keen feeders that they will rapidly diminish the already scanty supply and the fario will have a poor chance.

A male fontinalis is a fearful cannibal. I have on more than one occasion seen one tackle a fish of nearly his own size. He will seize a fish by the head and hold it with gill-covers pressed close till it is dead, or nearly so, and then swallow as much of it as he can, head first. As he is unable to get a fish approaching his own size more than a third swallowed at a time, he will lie, with body and tail of the prey projecting from his mouth, till the head is digested; then swallow a little more, till in time the whole disappears. This sort of thing is not an uncommon occurrence in a pond at spawning time, but I have never noticed it at other seasons. It is also possible that in a wild state they are not so outrageously unreasonable in their feeding habits.

CHAPTER IX

PREDATORY FISH

Pike—Method of Killing them—Pikes' Feeding Habits—
Delicate Flavour in May—Perch a favourite Prey—
Pikes' Long Fast—Their Marvellous Agility—Eels :
the worst Enemy of Trout.

DURING three or four years' war against the pike in a large lake, it was my good fortune to be able to collect a great quantity of interesting data concerning this fish. The work was undertaken with a view to stocking with trout, so that every means of killing the pike which could be thought of was adopted, short of dynamite and poison. These were not employed, because there were already a considerable number of trout in the lake, which we did not wish to destroy. All the captured pike which

passed through my hands were opened and the contents of their stomachs examined, so that valuable information was obtained as to their feeding habits at different seasons of the year.

The lake contained, besides a few trout and an enormous number of pike, quantities of perch, a fair number of rudd, a great many very large eels, and innumerable crayfish. Before proceeding further, I should like it to be understood that the following facts refer only to this one lake, and there is no reason to suppose that pike all over the country behave in exactly the same way; a long experience of fresh-water fishes leads me to believe that it is most dangerous to draw sweeping conclusions from a limited amount of evidence. At the same time, the facts here recorded may be a help to those who are wrestling with a similar task, and to pike fishermen, for a knowledge of a fish's feeding habits is a great help to those who wish to angle for him.

Of the many methods employed to catch the pike, the three principal and most effective were drift-nets, trimmers, and fishing from a boat with that excellent contrivance known as an "otter," which allows one man in a boat to fish with a dozen or more baits covering a strip of bottom from 100 to 200 yards wide. It is true that a first attempt to use an "otter" will result in nothing but profanity, in all probability; but a little practice soon enables one to make light work of what appeared to be hopeless difficulties to begin with.

We soon discovered that these three methods were seldom all effective at the same time. When the trimmers were working the "otter" was of very little use, though the nets would catch a few large pike deep down. When the "otter" was successful there would be plenty of medium-sized pike in the nets fairly high up; but the trimmers were doing very little good. The most curious discovery was that often for several consecutive

days "otter," trimmers, and nets were alike failures. On these occasions we used always to get a few trout in the nets and quantities of perch. It soon became evident that the pike varied their methods of feeding considerably, and apparently abstained from food at certain times for several days. The contents of the stomachs led to the same conclusion, for it was found that when the trimmers were catching fish, they, as well as those taken in the nets, were feeding on the bottom—chiefly on crayfish and perch. When the "otter" was successful the stomachs showed that the pike were feeding on perch only, with a trout very rarely. Out of many thousands of pike taken during four years, not a hundred had trout in them, and not in one single instance did we find a rudd. When neither "otters" nor trimmers were successful, and there was only an occasional pike in the nets, its stomach usually proved to be empty.

Operations were begun in February ;

but it was not until the middle of March that many pike were taken, and then chiefly in the nets. Towards the end of the month the trimmers caught a great number, and after the beginning of April all three methods were successful. In May we were amazed to find neither trimmers nor "otters" of any use, and the number caught in the nets was less; and the autopsies showed that the pike were feeding on the fresh-water shrimp. Not only the small jack, but also great fellows up to twenty pounds, were gorged with them, and during this time they were more delicate in flavour than at any other. The shrimp diet made such a difference to their table qualities that they compared favourably with trout. It seemed to me a very remarkable thing that such fish as pike, possessed of powerful jaws, a huge mouth, and armed with countless teeth, should condescend to feed on such trifling morsels as fresh-water shrimps. This diet satisfied them all through the month of May each year;

but at no other season did we find a trace of shrimps among their food.

During June they returned to a perch diet, and they kept to this until the end of July, varied only by an occasional crayfish. In August the young perch which had been hatched out in May began to occupy their attention, and the larger perch were left alone. These small fish were barely two inches long, and were just beginning to show the dark stripes on their sides. They kept chiefly to the shallows, and were fond of stagnant pools among the tall reeds. Under my boathouse they swarmed, and when we required any for bait we used to dip them out with a fine-mesh net on a ring. It was easy to drive them into a corner and scoop up scores at a time. The pike did not seem to bother them during the day; but in the cool of the evening, all night, and in the early morning they hunted them in the shallows with much splashing. From this time the pike gave up eating the larger perch, only occasional ones

being found in their stomachs, and confined their attentions to the youngsters. In December and through the winter months they took to large perch again.

It will be seen that perch formed the staple article of diet except during May. I never found an eel in a pike's stomach, though there were any quantity at hand, and I know that in many waters they make an excellent bait. I find in several books dealing with pike that there is a doubt as to whether they take perch freely, and in some cases it is recommended that the back fin be removed before they are used as bait. As pike always swallow their prey head first, the back fin simply folds down, and does not inconvenience them at all. It is quite clear that perch are the favourite food of the pike even in water where trout and other fish are to be found.

From careful observation I am satisfied that pike kill their prey before swallowing them, and they do this by holding whatever fish they have secured crossways in

their powerful jaws for some time before bolting it. I once watched a pike hold a perch in this way for twenty minutes, and then he moved off out of sight ; but from five to ten minutes is the usual time.

Though pike will eat an enormous quantity of food at a meal, they do not repeat this until a long interval has passed—often several days—and all the pike in a particular piece of water seem to feed or abstain from food at the same time. When those caught in the nets were examined, it was always found that they all contained food, or that they were all empty. Of course there were exceptions in each case ; but it was clear that whatever affected their feeding affected practically all alike.

That pike can stand a long fast without, apparently, being inconvenienced or losing weight I proved conclusively by keeping one in a tank in a hatchery which was supplied with fresh water only—by drippings from a spout. During that time the fish had no food ; yet when

it was weighed it did not seem to have lost in any way. It is true that during the whole three months the fish took no exercise ; it lay like a log, with only a slight occasional movement of the fins. It was lively and in perfectly good health when I finally removed it. Not only large pike, but also the fry, have this faculty for fasting. I once kept some pike fry, which were hatched out in a small ditch, for three years. At the end of that time they were only an inch and a quarter long, but quite healthy and well formed. Their only food had been infusoria. They did not seem able to tackle larvæ or water-beetles, and the amount of food they could get was evidently not sufficient to enable them to grow. During the dry weather there was hardly any water in the ditch ; but they seemed quite comfortable, and used to spend most of their time buried up to the eyes in mud. Their movements when three weeks old were exactly like those of larger pike, and it was very

interesting to watch them dart forward with a speed which rendered them almost invisible for a few feet, and then stop dead. Often when hunting about in shallow water I have disturbed a pike which has made off with such a rush that one would expect it was going far away, and then discovered it lying motionless not two fathoms off. The power of doubling which the hare possesses is not nearly so marvellous as this.

Although there were many creatures which the pike in the lake seemed fond of, such as young birds and frogs, I never came across any of these in their stomachs, though I did find a good many stones; and I have in my possession a stone weighing four ounces which I took from the stomach of a 12-lb. fish.

At the end of four years' hard work there was no appreciable difference in the number of pike in the lake. As large numbers of trout had been turned in, and the result was but partially satisfactory, it became apparent that there was another

enemy at work. This we soon found, and quite by accident. I had got an eel one evening on a line, and discovered that it was full of young perch and one small Rainbow trout. As I had turned out a few thousand of Rainbows the day before, I began to think I might be on the track of the real enemy. I mounted 600 eel-hooks on a long line, and baited these with ordinary earth-worms. This line was set at five o'clock one evening at the end of May. Next morning at six o'clock we lifted it, from a boat, and got 163 lb. of eels—the largest being 6 lb., and the average over 3 lb. A few of these were opened, and the result showed us clearly that we had been fighting the wrong enemy. The eels were the destroyers, and from one I took a trout just under six ounces in weight. Several tons of eels were caught during one summer alone ; but the supply seemed inexhaustible. The stocking with trout went on all the time ; but their increase in the lake was very slow. The result

of this experience showed us that we had two serious difficulties to face. On the one hand, if we turned in trout which were too large for the eels to destroy, they were, by reason of their upbringing, partially tame, and too easy a prey to the pike ; if, on the other hand, yearlings or fry were turned in, they were picked up by the eels immediately.

Any one undertaking to transform a large lake containing eels and pike into a trout preserve may reckon on from seven to ten years' ceaseless work before it is accomplished. My advice would be to make the destruction of the eels the chief work. They are greater enemies to trout than pike.

CHAPTER X

TROUT THAT DO NOT RISE

A Depressing State of Affairs—In some Waters Temporary only — The Explanation there — In other Waters Chronic—Pike Drive Trout to Bottom—Gulls also to blame.

ONE frequently hears of lakes containing large quantities of trout which afford very indifferent sport, owing to the fish not being free risers. Here again the remedy often applied is a change of blood ; but it is questionable whether there ever was a breed of fario which were such bad risers that a little manipulation of the feeding conditions would not very soon give satisfactory results. There is no doubt that in waters where bottom feeding is so abundant that the trout become lazy there is a tendency in the direction of a

TROUT THAT DO NOT RISE 165

breed of non-risers; but, on the other hand, it is possible even with such a breed to force them to become surface feeders. In a previous chapter it has been pointed out that hungry trout are invariably good sporting fish, and it is not necessary by any means that they should be half-starved and ravenous, like the trout in some of the hill lakes. When the balance between food supply and stock is maintained, there need be no fear that the fish will not rise. Only overfed or abnormally large trout are entirely bottom feeders when in their prime; but old fish in any water are almost sure to become lazy.

Some lakes contain trout which are good risers for a portion of the season, and at other times never come to the surface at all. When this is the case it will usually be found that March, April, and May are the best months, and that after June fly-fishing is hopeless.

The cause of this unfortunate state of affairs is the production of some form of food in large quantities during the

spring months, which affords the fish an abundant supply right on to the autumn. To ascertain what this food supply is, it may be necessary to net a number of trout and examine the contents of their stomachs. In most cases it will be found that the young of some other species of fish is at the bottom of the trouble. For example, a trout lake which contains perch is almost sure to be badly affected. These fish spawn in April and May, and their eggs hatch off rapidly. By the middle of June the water is teeming with shoals of perch fry, on which the trout gorge. This supply lasts them all through July and August, though by September the smaller trout begin to find the perch fry, now from two inches to two inches and a half long, rather large for them. The older fish continue to feed on perch right up to the time when they leave the lake on their way up to the spawning grounds. It cannot be too strongly urged that perch are not fish to be allowed in a trout water. Their sins are many, and they are not of

TROUT THAT DO NOT RISE 167

sufficient value as sporting or food fish to compensate for the mischief they do. We have seen how the old perch guard the inlets to the lake in huge shoals, patiently waiting for the luckless trout fry on their way down-stream to deeper water. This is alone sufficient reason for their destruction; but the fry will ruin the chances of sport during the summer months. There is nothing, so far as I am aware, that can be urged in their favour in a trout water unless there are also pike. If these terrible fish live in the lake with the trout, then, and then only, are perch valuable. They serve as a foil for the trout. In spite of all that has been said to the contrary, pike are very fond of perch, and particularly of the youngsters. As soon as the fry begin to show the dark bands—usually at the end of July—the pike, large and small, feed on them. I have caught pike over 12 lb. on an eel line baited with a small perch not over an inch and three-quarters long, and have found their stomachs full of fry. After a

considerable experience of pike and their ways, I am of opinion that they have no decided preference for trout, but will take a perch as readily. This, probably, is not so in all waters ; but where I have tested the matter it has invariably been the case. It will be seen, then, what a valuable foil the perch are ; but a trout water which contains both pike and perch is in a bad way, for these fish are both amazingly prolific, and their influence on the trout preserve is very harmful.

It is well to remember that it is not possible to lay down hard-and-fast rules. Though certain adverse conditions may in the majority of cases produce bad results, there will usually be found waters where these conditions prevail without detrimental effects being apparent. I know of one or two lakes where pike and perch and trout thrive together ; but where this occurs it is usually because the stock of trout is well maintained by caring for the welfare of the young or by heavy stocking.

TROUT THAT DO NOT RISE 169

Pike in a lake not only do an immense amount of harm by feeding on the trout, but also they tend to make them bottom feeders. Any trout feeding on or near the surface is plainly visible to the lurking pike with their upturned eyes. Well the trout know this! Their best chance for safety is to keep near the bottom, where they are near cover, and less likely to attract the attention of the pike.

It may happen that neither perch nor pike, nor any other kind of coarse fish, live in the lake, and yet for a month or two months, perhaps longer, the trout will not rise to the fly. When this is the case it will be found that some creature is specially abundant in the water at that time, and the simplest way to find out what this is is to net some of the trout and examine their stomachs. A careful autopsy is at all times of service in yielding knowledge of under-water conditions, which otherwise may only be guessed at, and it is strange that this method of investigation is so seldom employed.

Having ascertained what is causing the trout to be sluggish, a remedy may very often be found, and in nine cases out of ten the best remedy is to increase the stock of trout. Once again we may learn from the agriculturist. Grazing land which is not sufficiently stocked gets out of hand, and if overstocked will not maintain cattle or sheep at a normal standard of excellence. The same principle applies to a trout lake: only, as the conditions are more difficult to ascertain and control, a ceaseless watch must be kept. If the signs are neglected and no steps taken till very apparent results indicate the necessity for action in any direction, the labour will be much greater, and the time occupied in restoring the water to its former condition much longer than if the first signs had been accepted as a warning.

For many years gulls of various kinds have been getting more numerous on our coasts, and the colonies of black-headed gulls which nest inland, often a consider-

TROUT THAT DO NOT RISE 171

able distance from the sea, do a great deal of harm in certain districts to our fresh-water fisheries. A trout lake on which a colony of these birds takes up its abode during the spring and summer months can never yield as good sport as it would if they were not there. There are two reasons why this is so. The one which concerns us at present is that they destroy the valuable flies on which the trout should feed. May-flies, caddis-flies, stone-flies, and moths are all greedily snatched by the birds. On some lakes the crop of May-flies has been entirely ruined by the black-headed gulls. No sooner does one of the beautiful insects emerge from the larva and unfold its wings to the sun than it is pounced on by a gull. I have watched the gulls on a fine day in June "hawking" over a lake and taking every fly before it was fairly on the wing. This, of course, means that no eggs are laid, and in a few seasons the May-flies are as scarce as hornets, and a valuable food for the trout is lost. The

caddis-fly meets with the same fate, and where black-headed gulls abound the opportunities for the trout getting the flies are few. These birds seem never to sleep. I have watched them flying backwards and forwards over some favourite beat all day, and change from that to the meadows after dusk, when they snap up the ghost moths and no doubt any others which are about, and still they have been busy in the early hours of the morning screaming and wheeling, welcoming another day of destruction. The law does not allow any interference with these birds, and the County Councils have placed them under their special protection, though no one is able to say what good they do which will compensate for the mischief.

While on the subject of black-headed gulls, I may say that it is amazing how any observant people can declare that they do not take fish. An inquiry has been set on foot in the north of England into this matter, and evidence has been

TROUT THAT DO NOT RISE 173

taken from every available source, and nearly every witness declares this bird to be innocent so far as catching fish is concerned ; yet there must be thousands of people in the country as well aware as I am that whenever they get a chance at a fish they take it, and that they are remarkably clever at catching fish. I have frequently seen these birds drop on to the water with such force that they have disappeared below the surface, and in most cases they emerge with a fish in their bills, usually held by the head. With this they fly round for a considerable time, dangling their prey for all eyes to see before they swallow it.

The amount of harm done to our freshwater fisheries by gulls of various kinds—and the black-headed gull is perhaps the most insignificant sinner of its kind—is enormous. There seems to be a determined conspiracy on the part of those who know to hush up the depredations of these birds, which do more harm, on a salmon river, for example, during

May and June than any other creature which preys on fish.

There are many fine lakes in the country—in Ireland particularly—where large trout are plentiful, which are entirely ruined for angling by the pike, perch, eels, and black-headed gulls. But it is a significant fact that, though the pike, perch, and eels have always warred against the trout, angling has not been hopeless till the black-headed gulls became numerous.

The time will come when people will realise the mischief done by gulls, and then perhaps the County Councils will see fit to allow a fishery owner to keep them off his water.

One lake I have known for years is cursed with an increasing colony of black-headed gulls, which, when I saw them last, numbered about four thousand. It is about twelve years since they came. Before that time there was every year a strong rise of May-flies in June, and the trout fishing during that month was excellent. The last two seasons I was

TROUT THAT DO NOT RISE 175

there (1903 and 1904) I did not see two dozen May-flies altogether, though I was on the lake every day. In previous years I had watched them being devoured by the gulls, and when they failed the caddis-flies took their place in the diet of the beautiful but destructive birds.

Any one who has had an opportunity of studying the effect of black-headed gulls in large quantities on a trout lake cannot fail to have been struck with three important points which make them most undesirable neighbours. Their activity is tremendous, apparently unceasing, and they have regular beats over which they fly, usually in pairs, backwards and forwards, allowing no opportunity for a meal to escape them. They feed chiefly on flies, while during the night they hover ghost-like over the grass lands, seeking moths. Failing a fly diet, they will take fish up to an inch and a half long, or take to the land, where they find worms, beetles, etc.

It may seem too bad to give these

birds such a character. I have written strongly, because there is a tendency to protect them, from some sentimental motive, in spite of the injury they do.

CHAPTER XI

A SIZE LIMIT AND ITS RESULTS

Trout at Various Ages—When the May-flies are out—
Is a limit Harmless?—An Instructive Experiment—
Many returned Trout Die—Risk of Handling Fish
—Precautions—Alternative to a Limit.

As we have considered some of the natural causes which tend to produce a stock of non-rising trout, we may now look into another matter which frequently has similar results.

It would seem at first sight as if the fixing of a size limit beneath which all trout must be returned to the water would have only good results. The angler does not wish to take undersized fish from lake or stream, and so diminish the growing stock ; but it is very doubtful

whether a rule compelling their return is, in the end, beneficial.

It must be borne in mind that there is a tendency for trout to become sluggish risers as they grow older. This may be taken as a general rule in all waters; but where feeding is plentiful this influence is felt much earlier than in less favoured lakes or streams. Also, it may be said that as a general rule lake trout cease to be free risers earlier than river fish. A trout lives for about fourteen years, and sometimes as long as twenty years; but its value as a rising fish is practically gone after ten years of age in any water, and in most cases seven to eight years is the limit. As two- and three-year-olds trout are better risers than at any other time, and each year after this there is a falling-off in their keenness to come to the surface. This falling-off may be almost imperceptible each year; but by the time a trout has arrived at eight years of age the number of days in the year when it is feeding on

A SIZE LIMIT & RESULTS 179

the surface are very few. There are exceptions to this rule. For example, a rise of May-flies will cause old stagers which have not made a ring on the surface for more than eleven months to come up like three-year-olds. This state of affairs may last a fortnight—in some cases even a month; but after that they return to their lurking-places till the same thing occurs the following year. Many a man has been astonished at the size of the trout caught when the May-flies are on, and has admitted that such trout are never seen at other times. This is particularly noticeable in lakes.

The fixing of a size limit tends to hasten the time when trout lose their inclination to rise to the fly. Though they may be slow at learning a lesson, they do learn it. If you know of a small trout frequenting a particular place and take the trouble to experiment with it, you will learn how easily a fish may be taught not to rise at a fly. Take a rod with tackle sufficiently strong to secure

your fish (for he is a small one) without exhausting him unduly. Catch him every day until he has learned his lesson. You will find, as I have, that after being hooked three times he will be very difficult to catch again, and if you persist it will not be long before he will avoid all flies and content himself with other food. If you take him on light tackle, which necessitates his being thoroughly exhausted before being brought to the net, he will learn his lesson much more quickly; but probably, unless you are accustomed to the handling of trout, he will not survive this treatment long.

I do not think it is generally known that a considerable percentage of the undersized trout returned to the water die. If they have been feeding heavily and have full stomachs at the time, the risk is much greater than when their stomachs are empty; but in any case they are liable to be very badly injured. The reason is that nowadays such light tackle is used that a trout is frequently

A SIZE LIMIT & RESULTS 181

played till it collapses altogether ; then, with the handling necessitated by the removal of the hook, often very clumsily done, the fish is in a sorry state when returned to the water. It will sink to the bottom and lie on its side in a state of collapse for a considerable time. It may die without a further struggle ; but should it show signs of recovery the chances are against it in most cases. The first sign of returning life is a gentle movement of the gills, and if these are not obstructed recovery will be fairly rapid ; but a sick trout usually lies on its side, which means that one gill cover is closed. Even this handicap may be overcome if the bottom is clean ; but if the fish has fallen among weeds or on a muddy place its recovery is doubtful. In the former case, the weeds impede respiration ; in the latter, the first convulsive struggle of returning life stirs up the mud and the fish is choked.

All this may be the result following the return to the water of a fish

fairly played and skilfully handled ; but how many men are there who are so accustomed to the handling of live trout that they can do it without risk of injury ? A trout is a very much more delicate creature during the spring and summer months than during autumn and winter. In cold weather it will stand a good deal of rough usage ; in warm weather, none. A little pressure on the gills or too hard a grip across the stomach and the mischief is done. A man accustomed all his life to the handling of trout would not undertake the risk which the novice cheerfully incurs. I do not think any one who has worked among trout will contradict me when I say that to remove a trout over eight inches long, which has food in its stomach, from water at a temperature of 58 degrees or over, and keep it till it is sufficiently quiet to handle before replacing it, is an operation attended with grave risk.

Even the trout restored to the water after having a hook removed, which will

dart off as if nothing had happened, is not necessarily safe. It is badly frightened, and makes for shelter, and then frequently the collapse comes, from which it may never recover. The water of a lake at summer temperature is far from being stimulating to a sick fish, and the loss among returned trout in lakes is undoubtedly greater than in a stream. In the latter, if the fish is only slightly sick, the revivifying current will do wonders; but if it is in a state of coma the chances are that the slightly open gills will cause it to rest on the bottom with its head down-stream, in which position it will as surely drown as a man with his head under water.

To nurse a trout back to life, the best thing to do is to prop it up between stones in a natural position, with its head up-stream, in a place where there is a brisk current. If this treatment will not bring him round, no other will—at any rate, no other which is likely to be at the command of an angler on the banks of

a stream. The position of the current is an important point. For example, a current caused by a shallow at the end of a long pool would not possess the restorative power of a similar current at the head of a pool and at the foot of a long rapid. Water is quickly influenced by the air, and swiftly-running, broken water is very different from water flowing sluggishly.

There are, then, two important points to be considered when discussing the desirability of fixing a size limit :

The undoubted tendency to teach fish while they are young to regard a fly with suspicion.

The grave risk of loss following on the return of the fish to the water (particularly where the size limit is over eight inches) in warm weather.

We have now to consider the fish, which, as a result of a size limit, have early learnt to avoid flies. What are they doing, and in what way are they useful ? I am afraid the answers to these

A SIZE LIMIT & RESULTS 185

two questions are not very reassuring. In the first place, they are feeding on the bottom, and a considerable amount of their time as they grow older is taken up in hunting for small fry and lying in wait where the youngsters are likely to be found. They will not be caught unless bait-fishing is allowed, and while they yield no sport they are for many years a source of loss to the water. In the next place, they are only of doubtful use as breeders, for it is more than likely that their non-rising habits may in a generation or two become hereditary, and, further, after they are eight years old, although they have still a long life before them, their yield of eggs gets rapidly smaller, till finally they become barren fish, so that they are of little value to the stock.

It has been already pointed out that a successful way of ridding a water of these undesirables is to erect a trap, which will catch them on their annual migration to the spawning beds.

Instead of a size limit, which is, after all, an admission of the fact that the stock is inadequate, I would suggest the careful preservation and cultivation of eggs and fry. To begin to safeguard the trout when two years old or more is late in the day, and if this care for the fish dated farther back there would be no need for a size limit, for a certain amount of thinning out would then be necessary.

If a size limit is necessary—and I admit that under certain conditions it may be—then make it a small one. By having (say) a ten-inch size limit the risk is run of educating the fish so thoroughly before he reaches that size that when he has attained it he will no longer rise. In an average water, an eight-inch fish is a two-year-old, and I would make that size the limit—all smaller fish to be returned. In a water rather better than the average, nine inches would be a good limit, and in a first-class water ten inches. There are very few waters where a ten-inch limit should be necessary.

A SIZE LIMIT & RESULTS 187

I consider that a trout ought to be takable when he is two years and a half to three years old, and I should fix the size limit accordingly. If a limit is fixed so high that the trout are not takable till after they are three years old, the prospects of sport are not so good as they might be. To recapitulate: A trout will never rise again so freely as during the two- and three-year-old stages ; after that there is a slight annual falling off. If the size limit does not admit of the trout being taken till after they are three years old, there is a great probability that many of them will have been scared so thoroughly by that time that they will not rise, and so they are not only lost to the angler, but also in the ranks of undesirables.

While making this suggestion I am aware that it will not fit every case ; but, as an indication of the lines upon which to arrive at a satisfactory conclusion, it may be of service. Wherever possible—and in most cases there should be no

difficulty about increasing the stock—a size limit should be avoided.

Where there are pike in the water, a size limit would be of little service, for, though anglers would adhere to it, it is quite certain that pike would not.

In many waters it would be of much greater service to restrict the capture of young males than to turn back indiscriminately all fish under a certain size. As has been shown, the males are at all times freer risers than the females; but after the middle of August this is more marked than earlier in the season. It is extremely difficult—often, indeed, hardly possible—during spring and early summer to distinguish between males and females in their prime; but after the middle of August the shape of the fish will indicate their sex. Old males can be recognised, as a rule, at any time of the year by looking at their lower jaw, which is curved upwards, and they should always be killed; but these fish are seldom caught on the fly.

CHAPTER XII

SALMON AND TROUT

Conflicting Interests—Lower Reaches and Upper Reaches
—Trout Suffer more than Salmon—Exceptionally
Fortunate Streams—Agricultural Drainage—Putting
Two and Two Together—Bewildering Variety of
Crosses.

THOUGH there are many lakes and streams containing trout only, there are many waters which contain both salmon and trout. Unfortunately, the interests of the two species are rather conflicting. It is not possible to cultivate both in any water with unqualified success. To make the most of the fishing in any river or lake it is necessary to decide whether trout or salmon are to be fostered.

It is not unusual to find the middle and the lower reaches of a river devoted

to salmon, while in the upper reaches trout are of the greatest value to the angler. This state of affairs is bad ; but there is a definite reason for it, which will be readily understood. Though salmon generally run right up to the head waters of a river to spawn, in many cases they do not arrive there until the close season. In this way they are of absolutely no value to the community of anglers who fish the head waters, and they naturally turn their attention to trout.

As the spawning seasons of the two fish seldom coincide, there is a great destruction of eggs on the beds. Usually the salmon spawn later than the trout, in which case the eggs of the former are rooted up by the late-comers and washed away. It often happens, also, that the trout spawn later than the salmon ; in which case it is the latter fish which suffer. At any rate, it may be taken for granted that where both fish spawn on the same beds one or other

suffers ; which it is, depends on local conditions.

On the whole I am inclined to think, in spite of much that has been said and written to the contrary, that the trout suffer most all through. When the two lots of eggs hatch off and the alevins have come on the feed, it is the salmon fry, not the trout, which put up the best fight for existence. The young salmon are much keener feeders, and if food is scarce it is the trout which have to go short. This applies right up to the time when the smolts go to sea, as trout anglers know to their cost. The young salmon are a nuisance ; they are so keen that it is not an uncommon thing to hook two at a cast. No doubt they are a trouble, too, to the young trout, taking the best of their food before they have a chance ; it is fortunate indeed for the trout that they do not require such a large supply as their greedy cousins. It is, nevertheless, a fact that salmon parr will thrive where the native trout is

hardly able to exist—simply because it is such a much keener forager.

The proprietors of the upper reaches of a salmon river have rather hard luck. They have the salmon during close time only; their trout fishing, if sufficiently good to be worth anything, is an injury to the stock of salmon, and is at the same time injured by them.

There seems little doubt that a salmon river should be as free from trout as possible, and that it is hardly possible to maintain a really good stock of trout where salmon parr are numerous, unless there happens to be a very good food supply.

There are some rivers in the country which have an abundant area of spawning ground as well as a plentiful food supply for both the trout and the young salmon. Where such conditions exist the harm done to either species by the other is very small. On the other hand, the majority of salmon rivers are not provided with a very large area of spawn-

ing ground, and each year what there is is getting less in many districts owing to two increasing evils—pollution and a more perfect system of agricultural drainage. The latter difficulty is very hard to overcome or counteract. While the land is very much benefited, the rivers suffer, for floods rise rapidly to a great height and fall rapidly to a very low level. Gravel beds in which eggs are deposited are often washed away, and appear again in other places, and it also frequently happens that eggs spawned during a flood are left high and dry when the river falls. Disastrous as all this is to the ova, it is equally hurtful to the food supply, and the young of both salmon and trout when they come on the feed are compelled to drop down-stream to find food. The result is that very many of them are snapped up by large trout.

The normal level of most of our rivers is lower than it used to be, owing to the rapid way in which water is nowadays

drained away, and in the upper reaches—particularly in a mountainous country—the conditions are such that it is not possible for Nature's rearing grounds to turn out anything like the number of fish they did a hundred or even fifty years ago.

Where the conditions are so much against the production of a large number of young fish it is important to decide whether the small crop produced annually is to be largely trout or salmon. It is only natural that anglers at the head waters should vote for trout; these they can fish for throughout the season, whereas salmon come during the close time only, and the young salmon destroy the food of the trout, besides being a nuisance to the fly-fisher.

The other day I noticed in a column devoted to angling reports, that on a certain salmon river—one of world-wide fame—trout had been on the increase for several years, until now there is a better stock than any one can remember. This

was in the head waters, too. The cause was not even hinted at; but probably the increase in trout is due to a decrease in the numbers of young salmon.

Anglers as a rule are not very good hands at putting two and two together when matters concerning fish, outside the actual fishing for them, are concerned; but they have a considerable knowledge of isolated facts, which only need stringing together in proper order to make many points clear which affect them closely.

Here is a case in point. No angler whose knowledge of waters containing trout and salmon dates back for more than a year can fail to have been impressed by the voracious manner in which parr and smolts will take his flies without regard to size or kind. He puts it down to the fish's gameness and puzzles no more about it. Nevertheless, it means a great deal besides. A young salmon requires and actually procures about three times as much food as a trout of the same age.

The excessive vitality of the fish enables him to do this easily, and on account of it he is bound to do so. It follows that in a water where food is scarce—and this is more often the case than not—even if the absence of young salmon would not mean that there would be three times the number of trout, at any rate they would be better fed and larger fish. When trout improve in size or numbers in a salmon river the cause, unless there is some other definite reason for it, will usually be found to be a decrease in the number of salmon. These remarks concerning salmon apply equally to sea trout.

The lower reaches of a river are not much affected from the trout angler's point of view by the presence of salmon, except in so far as mischief going on in the head waters will affect the number of trout. During April, May, and June there will probably be a large number of smolts migrating to the sea, and there is no doubt they will temporarily affect the

food supply ; but this migration is at a time of year when insect life is abundant, and by the end of June these fish will nearly all have arrived in the brackish tidal waters.

One very curious fact regarding the migratory salmonidæ is that they will and do continually cross with the river trout. This occurs more frequently between brown trout and sea trout than between salmon and brown trout ; but I have more than once seen a male brown trout doing duty on the salmon redds.

The result of this crossing is bewildering in the extreme, and most of the disputes which arise concerning what is and what is not a salmon parr are due to it. As the law stands the trout angler is liable to a fine if he is found with young salmon in his possession ; yet so various are the markings of parr, half-breeds, and true trout, that in many cases no one can say definitely what they are. The water-bailiff is supposed to know, and he is usually prepared to swear one way or the

other, when an expert might be quite at a loss.

It frequently happens that the young of pure-bred *fario* at a trout farm show all the markings of a parr, and again it frequently happens that young salmon show no parr marks at all. In the smolt stage the difficulty of identification is much less; still, as regards the half-breeds one is at a loss, for some will put on the silvery coating and never go farther than the brackish waters, while some will lose their parr marks and develop into ordinary *fario*. The difficulty of identification is increased when one has to deal with quarter-breeds or with the progeny of a half-bred trout and salmon and a full-bred salmon.

In a water which contains salmon, sea trout and brown trout, there will be found fish which are the result of three forms of crossing—salmon and trout, sea trout and trout, salmon and sea trout. To make identification more difficult, the result of a cross between a male trout

and a female salmon produces fish with quite a different set of markings from a cross between a male salmon and a female trout. The same may be said of the other two crosses. Thus, besides the pure-bred fish, we have at least six other kinds which no one except a water-bailiff can identify.

There is one other point to be noted concerning salmon and trout in the same water. It frequently happens that salmon on their way up to spawn keep to the main river, or at any rate to the larger tributaries, while the trout more often run up small streams which do not tempt the salmon. In this way there is a certain provision for separating the two species, and when this occurs they do not disturb each other's eggs. Unfortunately, as before pointed out, there is frequently not a large enough area of suitable ground to accommodate both.

So far as it is possible to speak generally, it may be said that, though the presence of trout in a salmon river is to

a certain extent harmful, on the other hand the salmon do the trout much greater injury. There is continual warfare between both species ; but the salmon almost always comes off best.

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- (8.) T. Ford, The Fishery, Caistor, Lincs.
- (9.) Chirk Fishery, Chirk, North Wales.
- (10.) Cleobury Fishery, Bridgenorth, Shrops.
- (11.) Arrow Fishery, Pembridge, Hereford.
- (12.) Col. Custance, Weston Fishery, Norwich.
- (13.) Kennet Valley Fishery, Hungerford, Berks.
- (14.) Norton and Bradwell Fishery, Herts.
- (15.) Chess Trout Farm, Chorleywood, Herts.
- (16.) Wye Valley Fishery, Monmouth.
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- (19.) Brimpton Fishery, Reading.
- (20.) Buckland Fishery, Branton, Devonshire.
- (21.) Surrey Trout Farm, Shottermill, Haslemere, Surrey.
- (22.) Test Valley Fishery, Stockbridge, Hants.
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INDEX

- Alevins, deformed, 15, 16
 - emerging from eggs, 18
 - sheltering of, 18
- Black-headed gulls, 171, 173, 174
- Bottom feeding, fish take to, 138, 139, 148
- Breeders, old trout as, 26
- Cannibalism, tendency to, 25, 142
- Cannibals, male fontinalis as, 151
 - male trout as, 32
 - old and large trout as, 84
- Corixa, the, 138
- Cyclops, 35, 36
- Daphnia, the, 35, 36
- Disease, in alevin stage, 35
- Drainage, system of land, 14
- Eggs, alevins emerging from, 18
 - depositing of, 7
 - examination of, 15
 - fertilisation in swirling torrents, 15
 - fertilised, 16
 - in a lake, 105
 - in gravel beds, 193
 - in redds, 17
- Eggs—
 - infertile, 28
 - moving of, 117
 - packing of, 55, 56
 - preservation and cultivation of, 186
 - saving of, 111
 - scarcity of fertile, 29
 - unfertilised, 13, 14
 - waste of, 8, 27, 32
 - weight of, 13
- Enemies, commonest, 62
 - in spring-time, 20
 - of fry, 123
 - protection from, 11, 35
 - worst, 19, 65
- Eyed ova, 14, 28
- Feeding, difference of, 125
- Females, proportion of, 11
 - quantity of, 31
 - quantity of offspring, 25
 - sorting of, 110
- Fertilisation, chances of, 8
 - in swirling torrents, 15
 - saving of eggs owed to perfect, 111
- Fish-culturists, 31, 125, 130, 133, 140, 141, 144
- Floods, 15, 40, 92, 193
 - winter, 97
- Flood-scoured river, 86
- Fly, the, 32

- Fly-fishing, harm of, 25, 31
Fontinalis, the, 150
 as a cannibal, 151
 Food, 81-103
 advisability of prolific, 136
 agricultural drainage
 harmful to, 193
 Corixa as prolific, 136
 Cyclops, 35, 36
 Daphnia, 35, 36
 flies, 35, 37
 for trout food, 135
 Gammari, 35
 grown in still water, 87
 insect, 41
 larvæ, 37, 47, 48
 mollusca, 36, 37, 47, 48
 natural, 42
 nurseries, 85
 of young fish, 34, 35
 of young salmon, 195
 scarcity of, 36
 shrimps, 47, 48
 streams with plenty of, 82
 the best, 38
 trout taken by young
 salmon for, 191
 water plants as producers,
 40
 worst kind of, 139
 Fresh, a, 14
 stream after a, 39
 Fresh-water shrimps, 36, 50,
 89, 133, 156
 Frost, effect of, at time of
 hatching, 17

 Gammari, 35
 Gravel beds, eggs in, 193
 Gulls, 173

 Hatchery, a, 16, 26, 28, 54
 Hatching, 17, 18
 Hilly country, stream in, 14

 Incubation, time of, 17

 Lake, falling off of fish in a,
 26
 knowledge of conditions
 prevailing in a, 105
 Larvæ, 35, 37, 86
 Limnea, 53

 Males, breeding, 33
 caught by fly-fishing, 31
 dealing with old and use-
 less, 112
 proportion of, 11, 12
 quantity of offspring, 25
 restriction in capturing
 young, 188
 shortness of, 30
 sorting of, 110
 Mollusca, 35, 37, 86, 88, 138

 Oxygen, 8

 Poison, 45-67
 Poisonous moss, result of, 55
 Pollution, causes of, 47
 from water drained by im-
 pure sources, 51
 increase of, 193
 modes of, 45
 stream affected by, 46
 temporary, 59

 Rainbow trout, 141, 143, 145,
 146, 148, 149, 150
 Redds, containing eyed ova,
 15
 eggs in, 17, 28
 sampling of, 13
 shape of, 12

 Salmon, food required by
 young, 195

- Salmon—
 - fostering of either trout or, 189
 - fry, 191
 - importance of choice between trout or, 194
 - in waters containing, 198
 - migration of, 197
 - reaches devoted to, 190
 - saprolegnia among, 114
 - trout harmed by, 200
 - in upper reaches, 192
- Saprolegnia, epidemic of, 114
- Sea trout, 197
- Size limit, in heavily fished waters, 32
- Spate, a, 59
 - autumn, 60
- Spawners, coming of the, 9
 - trap for, 104
- Spawning, date of, 11
 - development after, 17
- Spawning beds, artificial, 21
 - dirt in, 7
 - laying of eggs in artificial, 134
 - points to be observed, 11
 - position of, 20
 - suitable places for, 7
- Spawning ground, effect of
 - distance, 10
 - importance of condition of, 16, 17
- Spawning season, length of, 10
- Sphagnum, bed of, 52, 53, 54
 - eggs packed in, 56
 - moss, 55
- Springs, fed by streams, 10
- Stagnant ditch, uses of, 38
- Stagnant places, after a fresh, 39
- Stagnant ponds, pollution
 - caused by, 51
- Stocking, harm of haphazard and impulsive, 128
 - with knowledge, 131
- Temperature, a neutralising
 - agency, 60
 - affected by atmosphere, 17
 - different conditions of, 125
 - effect on eel, 35
 - importance of, 137
 - requirements according to, 134
- Trap, for spawners, 104
- Trout farms, 125, 126, 198
- Waters, poisonous, 38, 39
 - stagnant, 36, 41, 43, 102
- Worm-fishing, necessity of, 32

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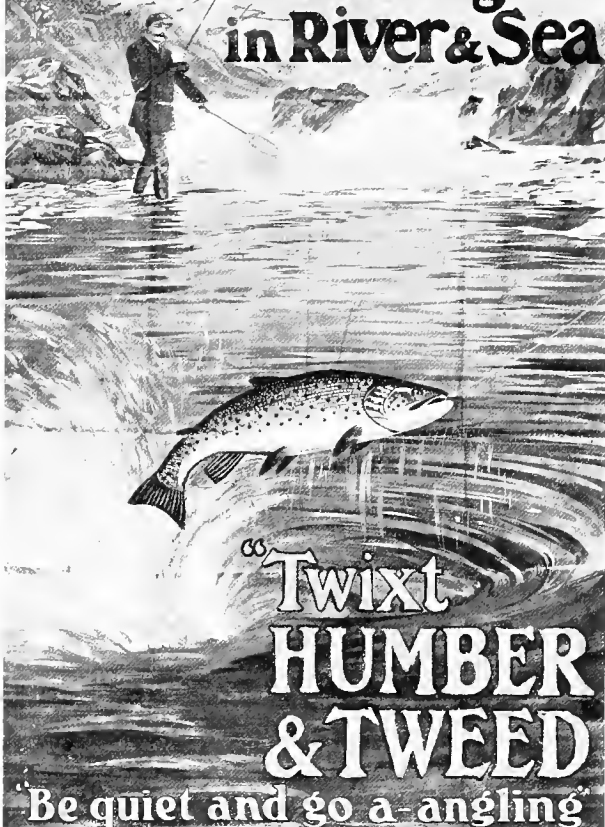
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